SPI'S COMMITTEE ON RESIN STATISTICS

The Committee on Resin Statistics, only one of the more than fifty Operating Units within the Society of the Plastics Industry is composed of 100 representatives from plastics resin producing companies, trade publications, industry-related professional organizations, and various agencies of the Federal government. All members of the Committee are quite knowledgeable of the rapidly growing plastics industry and have a special interest in the development of marketing and economic data.

At present the Committee is responsible for the development and maintenance of a monthly report on the major plastics materials. This report shows monthly and cumulative data on Production and Sales & Use (including captive operations) with percent change from the previous year. It is the only detailed monthly report on plastics materials now available. There are one hundred twenty-five producers participating in the monthly program and they are believed to represent about 95% of total U.S. plastics production. Many of the materials covered reflect 100% industry coverage. The data are compiled by Ernst & Whinney, nationally renowned Independent Public Accountants.

The Committee is actively involved with the various departments of the Federal Government (International Trade Commission, Department of Commerce, Bureau of the Census, Bureau of Labor Statistics, etc.) assisting them in the development and improvement of the plastics segments of their special reports.

The Committee is also responsible for monitoring all resin data which appear in FACTS & FIGURES, thus assuring the most accurate and timely data available on the plastics industry.

A8920-1

1985 edition

Facts & Figures of the U.S. Plastics Industry

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First Printing: September 1985

FACTS & FIGURES is prepared annually by H. Kibbel of the Information Services Department. All inquiries regarding its content should be addressed to that department at the Society of the Plastics Industry, Inc., 355 Lexington Avenue, New York, N.Y. 10017.

Price: $55.00 (SPI members); $110.00 (non-members)

THE SOCIETY OF THE PLASTICS INDUSTRY, INC.

The Society of the Plastics Industry, Inc. is a member-run federation dedicated to promoting and protecting continuing growth for the plastics industry in the United States. The Society represents more than 1,700 member companies responsible for over 95 percent of plastics materials production.

SPI's 50 operating units and more than 300 committees have membership drawn from all segments of the industry—processors, resin and adjuvant suppliers, plastics distributors, machinery builders, and moldmakers. The Society serves as a federation of semi-autonomous, interrelated groups with a strong, common interest in the overall health of the plastics industry.

SPI serves as the "industry spokesman." It identifies and provides positive rsponses to misinformation and to potentially harmful regulations, bills, or court decisions by mobilizing pertinent facts and carrying out programs for timely and forceful action. At the same time, SPI works to prevent such damaging situations from occurring by building a positive understanding of the industry. The Society's service committees provide liaison with government agencies, code and regulatory groups, and many other associations.

SPI sponsors research projects in areas such as energy use, resource recovery, combustibility, and worker safety, at major private research organizations. The Society conducts numerous information programs, providing literature, surveys, reports, newsletters, and handbooks for industry and public use.

SPI sponsors one of the largest trade shows in the United States—the National Plastics Exposition, held every three years. The most recent show was held in June 1985, again at McCormick Place in Chicago.

Incorporated in 1937, SPI has grown with the dynamic industry it represents. In addition to the Society's headquarters office at 1025 Connecticut Ave. NW, Suite 409, Washington, D.C. 20036, SPI has four section offices: Eastern Section, 169 Union Boulevard, Totowa, NJ 07512; New England Section, 20 Speen Street, Framingham, MA 01701; Midwestern Section, 3150 Des Plaines Avenue, Des Plaines, IL 60018; and Western Section, Saddleback Square, Suite 124, 12440 Firestone Boulevard, Norwalk, CA 90650 plus a New York Office, 355 Lexington Ave., NY, NY 10017.

SPI draws together the diverse segments of the plastics industry into an effective organization that represents the entire industry.

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DEVELOPMENT OF TODAY'S PLASTICS

Today's plastics are one of the most used material on a volume basis in America's industrial and commercial life. The role of plastics is so broadly integrated in our own lifestyle that today there is virtually no product area where plastics do not make a major, irreplaceable contribution. Although the plastics industry in the United States is now in its second century, the most important developments have occurred since 1910. However, the roots of these modern developments go back not only to the research of cellulose nitrate by John Wesley Hyatt in the 1860's, but also to the plastic-like compositions used by man through the centuries.

ORIGIN OF PLASTICS

One can go as far back as the Old Testament to find references about natural materials used as fillers, adhesives, coatings, and the like. These materials were the precursors of what we call plastic materials today. Consequently, historians differ as to the exact date that the plastics industry began, and they will continue to do so since an exact year or even decade for the event is a matter of interpretation as to what constitutes a "plastic."

Certainly the history of the rubber industry has a bearing on plastics since ebonite, or hard rubber, discovered in 1851, was the first thermosetting material to be prepared and also the first material which involved a distinct chemical modification of a natural material. But ebonite was not exploited commercially for some years after its discovery and for that reason its historical importance has become somewhat blurred.

EUROPEAN DEVELOPMENTS

While the basic processes of rubber technology were developing, other important discoveries were taking place in Europe. Following work by Pelouze, Schonbein was able to establish conditions of controlled nitration of cellulose. The product soon became of interest as an explosive and in the manufacture of collodion, a cellulose solution in an alcohol-ether mixture. In the 1850's the English inventor Alexander Parkes observed that the solid residue left after the evaporation of the solvent of photographic collodion was a "hard, horny elastic and waterproof substance." In 1856 he patented the process of waterproofing woven fabrics by the use of such materials.

In 1862 the Great International Exhibition was held in London. It was there that Parkes introduced a new material named for himself—Parkesine. Parkesine was obtained by dissolving cellulose nitrate in a minimum of solvent. The mixture was then put on a heated rolling machine from which some of the solvent was then removed. While still in the plastic state the material was then shaped by dies or pressure. In 1866 Parkes organized the Parkesine Company to manufacture products from his new material, but the company failed in 1868. This appears in part due to Parkes' attempt to reduce production costs which resulted in the production of inferior items.

One year after the failure of the Parkesine Company, an associate of Parkes, Daniel Spill, formed the Xylonite Company to manufacture products similar to Parkesine. Once again economic failure resulted and Spill's company went bankrupt in 1874. Undaunted, Spill moved to a new site, established the Daniel Spill Company and continued production of his material, Xylonite.

FIRST PLASTICS IN THE U.S.

In the United States during the 1860's someone else was experimenting with cellulose nitrate—John Wesley Hyatt. In 1865 Hyatt became involved in devising a method for producing billiard balls from materials other than ivory. Originally using mixtures of cloth, ivory dust and shellac, in 1869 he patented the use of collodion for coating billiard balls. The patent came one year after his collodion material was introduced commercially.

John W. Hyatt and his brother Isaiah took out U.S. Patent 105,338 in 1870 for a process of producing a horn-like material using cellulose nitrate and camphor. Although Parkes and Spill had mentioned camphor in their work it was the Hyatt brothers who recognized the value of camphor as a plasticizer for cellulose nitrate. In 1872 the term celluloid was coined by Isaiah Hyatt to describe the Hyatts' commercially successful product.

The validity of Hyatts' patents was challenged by Spill and a number of court actions took place between 1877 and 1884. In the final action it was found that Spill had no claim on the Hyatt brothers, the judge ruling that the true inventor of the process was Parkes since he (Parkes) had mentioned the use of camphor in his patents. Thus, there was no restriction on the use of these processes and any company, including the Hyatts' Celluloid Manufacturing Company, were free to use them. After that decision the Celluloid Manufacturing Company prospered, changed its name to the American Celluloid Chemical Corporation, and eventually was absorbed by the Celanese Corporation.

FORMALDEHYDE RESINS

Next to cellulose nitrate the most important material in the early history of plastics was formaldehyde. Around 1897 there was a demand in German schools for a white chalkboard. Efforts to obtain such a product resulted in the discovery of casein plastics, produced by reacting casein (milk protein) with formaldehyde. The material soon became established under the trade names of Galalith and Erinoid, and today casein is still used by the button industry.

In 1899 Arthur Smith took out British Patent 16,274, the first dealing with phenol-formaldehyde resins, in this case for use as an ebonite substitute in electrical insulation. During the next decade the phenol-formaldehyde reaction was investigated mainly for academic interest. In 1907 however, Leo Hendrik Baekeland discovered techniques of so controlling and modifying the reaction that useful products could be made from it. Thus phenolics were the first fully synthetic resins to become commercially successful.

Prompted by the success of phenolic moldings, research began on reacting other materials, such as urea and thiourea, with formaldehyde. These materials were used in the manufacture of molding powders. Unlike the phenolics, they could be molded into light-colored articles and they rapidly achieved commercial success. Today these urea-based resins are used for molding powders, adhesives, and textile and paper finishing while the related melamine-formaldehyde resins are used in decorative laminates.

GROWTH OF MODERN PLASTICS

Cellulose acetate, a thermoplastic, was developed about the same time as the urea-based resins. Similar in structure to cellulose nitrate, it was found to be safer in processing and use. Cellulose acetate was introduced as a molding compound in 1927.

The period 1930-1940 saw the initial commercial development of today's major thermoplastics; polyvinyl chloride; low density polyethylene; polystyrene; and polymethyl methacrylate. The advent of the Second World War in 1939 brought plastics into great demand, largely as substitutes for materials in short supply, such as natural rubber. In the United States the crash program leading to large-scale production of synthetic rubbers resulted in extensive research into the chemistry of polymer formation, and eventually, to the development of more plastic materials.

The first decade after World War II saw the development of high density polyethylene and polypropylene and the growth of the newer plastics in many applications. Large-scale production of these materials reduced their cost dramatically. The new materials began to compete with the older plastics and even with the more traditional materials such as wood, paper, metal, glass and leather. Since that time the demand for plastics has increased steadily so that plastics are now accepted by designers and engineers as basic materials along with the more traditional materials. The automotive industry, for instance, relies on plastics to reduce weight and thus increase mileage.

INTRODUCTION OF PLASTICS RESINS

DATE	MATERIAL	EXAMPLE
1868	Cellulose Nitrate	Eye Glass Frames
1909	Phenol-Formaldehyde	Telephone Handset
1919	Casein	Knitting Needles
1926	Alkyd	Electrical Bases
1927	Cellulose Acetate	Tooth Brushes
1927	Polyvinyl Chloride	Wall Covering
1929	Urea-Formaldehyde	Lighting Fixtures
1935	Ethyl Cellulose	Flashlight Cases
1936	Acrylic	Brush Backs
1936	Polyvinyl Acetate	Flash Bulb Lining
1938	Cellulose Acetate Butyrate	Packaging
1938	Polystyrene	Housewares
1939	Nylon	Gears
1939	Polyvinylidene Chloride	Packaging Film
1939	Melamine-Formaldehyde	Tableware
1942	Unsaturated Polyester	Boat Hulls
1942	Low Density Polyethylene	Packaging
1943	Fluoropolymers	Industrial Gaskets
1943	Silicone	Motor Insulation
1945	Cellulose Propionate	Pens and Pencils
1947	Epoxy	Tools and Jigs
1948	Acrylonitrile-Butadiene-Styrene (ABS)	Luggage
1954	Styrene-Acrylonitrile (SAN)	Housewares
1954	Polyurethane	Foam Cushions
1956	Acetal	Automotive Parts
1957	High Density Polyethylene	Milk Bottles
1957	Polypropylene	Safety Helmets
1957	Polycarbonate	Appliance Parts
1959	Chlorinated Polyether	Valves and Fittings
1962	Phenoxy	Bottles
1964	Ionomer	Skin Packaging
1964	Polyphenylene Oxide	Battery Cases
1964	Polyimide	Bearings
1964	Ethylene-Vinyl Acetate	Adhesives and Coatings
1965	Polysulfone	Electrical/Electronic Parts
1970	Thermoplastic Polyester	Electrical/Electronic Parts
1973	Polybutylene	Piping
1973	Polyphenylene Sulfide	Telecommunications
1974	Polyethersulfone	Printed Circuit Boards
1975	Nitrile Barrier Resins	Non-food Packaging
1978	Linear Low Density Polyethylene	Extruded Film
1982	Polyetherimide	Electrical/Electronic Parts
1983	Polyetheretherketone	Wire and Cable

1984 IN REVIEW—PRODUCTION AND SALES & CAPTIVE USE*

(in millions of pounds)

RESIN	PRODUCTION			SALES & CAPTIVE USE		
	1984	1983	%CHANGE	1984	1983	%CHANGE
Epoxy	406	334	21.6	379	331	14.5
Phenolic	2,502	2,484	0.7	2,510	2,529	– 0.8
Polyester	1,232	1,084	13.7	1,231	1,072	14.8
Urea	1,199	1,172	2.3	1,189	1,167	1.9
Melamine	210	180	16.7	197	181	8.8
Total Selected Thermosets	5,549	5,254	5.6	5,506	5,280	4.3
ABS	1,128	n.a.	—	1,098	n.a.	—
SAN	99	93	9.7	88	91	– 3.3
HDPE	6,085	5,691	6.9	5,949	5,707	4.2
LDPE	8,413	8,041	4.6	8,416	8,045	4.6
Nylon	396	321	23.4	389	329	18.2
Polypropylene	4,940	4,434	11.4	4,816	4,464	7.9
Polystyrene	3,838	3,567	7.6	3,836	3,606	6.4
PVC	6,760	6,066	11.4	6,798	6,152	10.5
Thermoplastic Polyester	899	778	15.6	859	783	9.7
Total Selected Thermoplastics	32,558	28,991	12.3	32,249	29,177	10.5
Total Selected Plastics	38,107	34,245	11.3	37,755	34,457	9.6
All Other Plastics	6,229	6,632	– 6.1	5,572	6,045	– 7.8
Grand Total	44,336	40,877	8.5	43,327	40,502	7.0

* Excludes Polyurethane. n.a.=not available

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

1984 IN REVIEW—
DISTRIBUTION OF SALES & CAPTIVE USE BY MAJOR MARKET

(in millions of pounds)

MAJOR MARKET	1984	1983	% CHANGE	SHARE OF TOTAL	
				1984	1983
Transportation	2,109	1,896	11.2	4.9%	4.7%
Packaging	12,398	11,813	5.0	28.6	29.2
Building/Construction	9,691	8,552	13.3	22.4	21.1
Electrical/Electronic	2,757	2,514	9.7	6.4	6.2
Furniture/Furnishings	2,117	2,007	5.5	4,9	5.0
Consumer/Institutional	3,986	3,816	4.5	9.2	9.4
Industrial/Machinery	400	318	25.8	0.8	0.8
Adhesives, Inks & Coatings	1,993	1,800	10.7	4.6	4.4
Other	4,080	3,636	12.2	9.4	9.0
Exports	3,796	4,150	– 8.5	8.8	10.2
Total	43,327	40,502	7.0	100.0%	100.0%

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

TOTAL U.S. PRODUCTION AND SALES & CAPTIVE USE OF PLASTICS RESIN; 1959–1984

(in millions of pounds)

YEAR	PRODUCTION (Including) Polyurethane	SALES & CAPTIVE USE (Including) Polyurethane)
[a]1959	5,992	5,157
1960	6,321	5,363
1961	6,930	6,040
1962	8,197	7,150
[b]1963	9,364	7,632
1964	10,525	8,847
1965	12,219	11,035
1966	14,199	11,726
1967	14,473	12,284
1968	17,231	15,396
1969	19,720	16,495
1970	20,056	17,494
[c]1971	21,161	19,813
1972	26,475	25,504
1973	29,213	28,719
1974	29,274	27,890
1975	22,828	22,278
1976	29,196	28,379
1977	33,948	32,771
1978	37,605	36,818
1979	41,577	40,607
1980	37,347	36,896
1981	39,867	38,801
1982	36,607	36,639
1983	42,777	42,212
1984	46,336	45,221

[a]U.S. Tariff Commission data used for 1959–1970. May exclude some captive use.
[b]Cellulosics not included through 1962. Included beginning in 1963.
[c]SPI data used for 1971–1984.

	Compound Growth Rate	
Years	Total Production	Sales & Captive Use
1959–1984	8.5%	9.1%
1969–1984	5.9%	7.0%
1974–1984	4.7%	5.0%
1979–1984	2.2%	2.2%
1983–1984	8.3%	7.1%

TOTAL U.S. PLASTICS PRODUCTION AND SALES & CAPTIVE USE BY RESIN

(in millions of pounds)

	1975		1976		1977		1978		1979	
RESIN	P	S & CU	P	S & CU	P	S & CU	P	S & CU	P	S & CU
Epoxy	198	187	244	250	261	278	299	316	361	332
Phenolic	1,051	1,034	1,340	1,305	1,458	1,400	1,617	1,543	1,781	1,732
Polyester	834	771	1,042	959	1,061	1,045	1,209	1,198	1,147	1,152
Urea	690	685	821	809	963	951	1,122	1,103	1,367	1,355
Melamine	115	117	186	182	200	203	202	196	200	192
Total Selected Thermosets	2,888	2,794	3,633	3,505	3,943	3,877	4,449	4,357	4,856	4,763
ABS	642	621	988	925	1,069	1,057	1,134	1,118	1,191	1,183
SAN	109	75	113	104	115	113	120	121	124	126
HDPE	2,468	2,305	3,125	3,127	3,652	3,557	4,201	4,165	5,010	4,893
LDPE	4,743	4,725	5,813	5,765	6,471	6,488	7,111	7,147	7,793	7,815
Nylon	135	143	247	221	254	250	275	278	327	315
Polypropylene	1,902	1,903	2,632	2,536	2,747	2,698	3,074	3,055	3,841	3,894
Polystyrene	2,662	2,640	3,195	3,145	3,446	3,557	3,823	3,870	4,005	3,997
PVC	3,648	3,615	4,716	4,638	5,253	5,232	5,723	5,810	6,119	6,138
Thermoplastic Polyester	—	—	—	—	—	—	—	—	—	—
Total Selected Thermoplastics	16,310	16,027	20,829	20,461	23,007	22,952	25,461	25,564	28,410	28,361
Total Selected Plastics	19,198	18,821	24,462	23,966	26,950	26,829	29,910	29,921	33,266	33,124
All Other Plastics	3,630	3,457	4,734	4,413	6,998	5,942	7,695	6,897	8,311	7,483
Grand Total	22,828	22,278	29,196	28,379	33,948	32,771	37,605	36,818	41,577	40,607

P=Production S & CU=Sales & Captive Use

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

TOTAL U.S. PLASTICS PRODUCTION AND SALES & CAPTIVE USE BY RESIN (Cont'd)

(in millions of pounds)

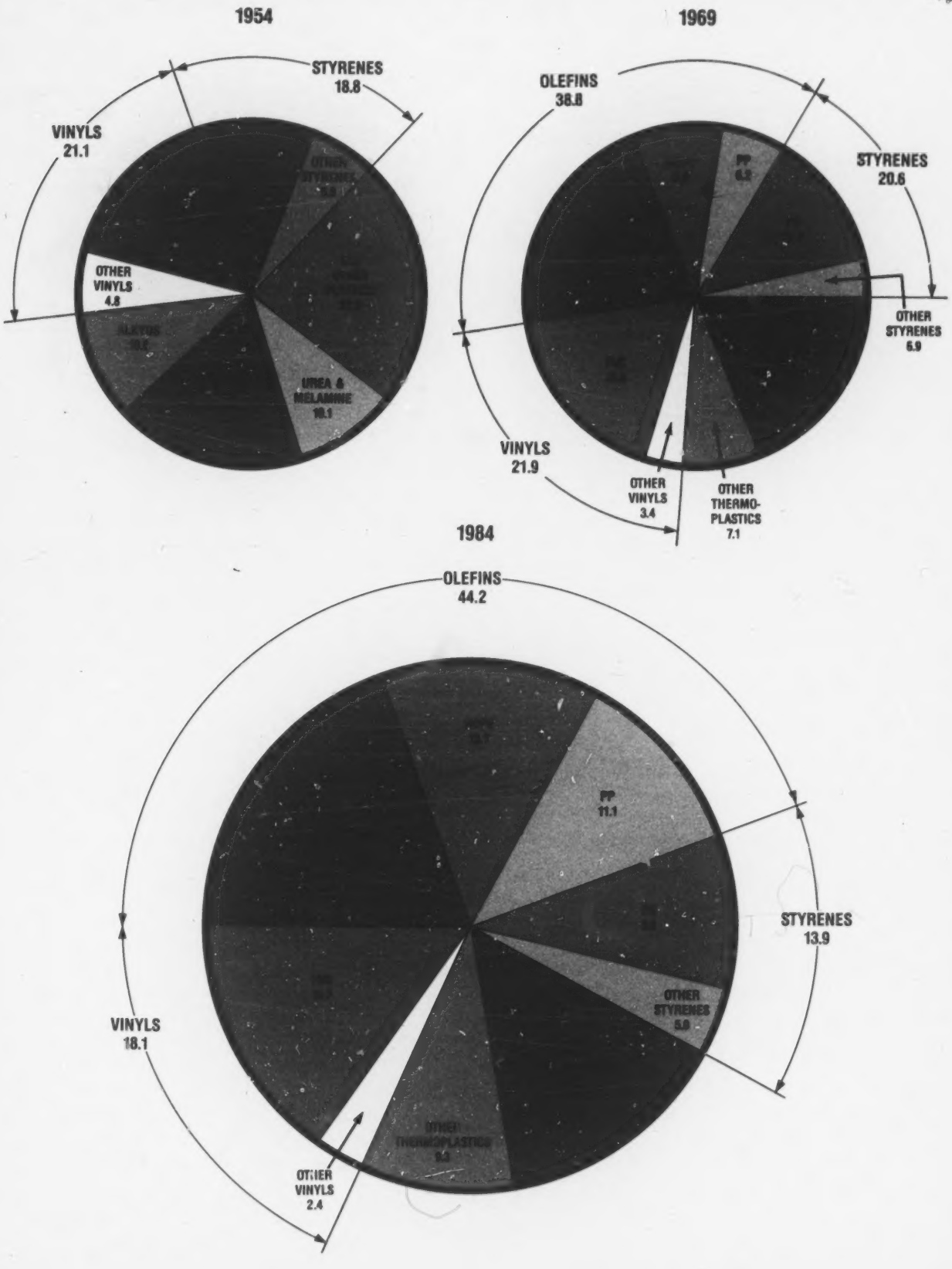
1980		1981		1982		1983		1984		Compound Growth Rate 1974–1984
P	S & CU	P	S & CU	P	S & CU	P	S & CU	P	S & CU	S & CU
315	319	336	332	286	301	334	331	406	379	4.7%
1,499	1,517	2,333	2,375	2,006	2,060	2,484	2,529	2,502	2,510	**
947	949	997	977	865	851	1,084	1,072	1,232	1,231	3.1
1,165	1,147	1,165	1,139	998	976	1,172	1,167	1,199	1,189	3.8
167	166	179	175	158	155	180	181	210	197	2.4
4,093	4,098	5,010	4,998	4,313	4,343	5,254	5,280	5,549	5,506	**
920	916	916	900	740	737	n.a.	n.a.	1,128	1,098	3.0
111	103	107	105	91	85	93	91	99	88	–3.0
4,405	4,394	4,695	4,683	4,928	5,024	5,691	5,707	6,085	5,949	8.3
7,291	7,467	7,693	7,516	7,503	7,687	8,041	8,045	8,413	8,416	3.4
274	271	312	288	228	247	321	329	396	389	7.8
3,648	3,714	3,955	3,888	3,477	3,623	4,434	4,464	4,940	4,816	8.2
3,521	3,518	3,621	3,604	3,191	3,200	3,567	3,606	3,838	3,836	1.8
5,470	5,407	5,707	5,601	5,326	5,455	6,066	6,152	6,760	6,798	3.7
503	511	610	581	648	619	778	783	899	859	n.a.
26,143	26,301	27,616	27,166	26,132	26,677	28,991	29,177	32,558	32,249	5.0
30,236	30,399	32,626	32,164	30,445	31,020	34,245	34,457	38,107	37,755	4.9
7,111	6,497	7,241	6,637	6,162	5,619	8,532	7,755	8,229	7,466	5.1
37,347	36,896	39,867	38,801	36,607	36,639	42,777	42,212	46,336	45,221	4.9%

P=Production S & CU=Sales & Captive Use n.a.=not available.

**Not applicable since reporting on gross weight basis begun in 1981.

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

PERCENTAGE DISTRIBUTION OF PLASTIC SALES & CAPTIVE USE BY MATERIAL



PLASTICS RESINS DOMESTIC MERCHANT SALES

(in millions of dollars and millions of pounds)

RESIN	1984		1983		% CHANGE	
	Net Dollar Value	Quantity	Net Dollar Value	Quantity	Net Dollar Value	Quantity
Low Density Polyethylene	$ 2,438	6,593	$ 2,836	6,322	−14.0	+ 4.3
Polyvinyl Chloride	1,806	5,800	1,609	4,937	+12.2	+17.5
High Density Polyethylene	1,660	5,028	1,501	4,606	+10.6	+ 9.2
Polystyrene	1,444	3,305	1,375	3,190	+ 5.0	+ 3.6
Polypropylene	1,228	3,242	1,054	2,941	+16.5	+10.2
ABS	804	996	728	924	+10.4	+ 7.8
Unsaturated Polyester	745	1,216	631	1,053	+18.1	+15.5
Thermoplastic Polyester	556	759	534	697	+ 4.1	+ 8.9
Nylon	521	338	431	282	+20.9	+19.9
Epoxy	473	338	415	296	+14.0	+14.2
Other Styrenes	471	739	544	781	−13.4	− 5.4
Phenolic	413	1,528	378	1,760	+ 9.3	−13.2
Urea	197	1,074	206	1,044	− 4.4	+ 2.9
Other Vinyls	161	89	149	92	+ 8.1	− 3.3
Melamine	137	154	125	138	+ 9.6	+11.6
SAN	50	72	54	75	− 8.0	− 4.0
All other (excluding polyvinyl acetate and polyurethane	4,035	2,535	3,437	2,168	+17.4	+16.9
Total	$17,139	33,806	$15,557	31,306	+10.2	+ 8.0

Domestic merchant sales are quantities of sales excluding interplant transfers, captive consumption and exports.

Net dollar value represents the actual selling price after deductions for cash discounts, quantity discounts, returned goods and allowances, federal excise taxes, local taxes, and outgoing transportation (prepaid or otherwise) to warehouses or customers.

Source: SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

APPARENT U.S. CONSUMPTION OF SELECTED PLASTICS RESINS

Apparent consumption is calculated by adding imports to production then subtracting exports. It is an accurate measure of the quantity of material actually consumed in the United States.

For purposes of the table below, the production figures were taken from SPI's Monthly Statistical Report, as compiled by Ernst & Whinney. Both the import and export figures were taken from Bureau of the Census reports.

1984
(in millions of pounds)

RESIN	PRODUCTION	IMPORTS	EXPORTS	APPARENT CONSUMPTION
Low Density Polyethylene	8,413	216	840	7,789
Polyvinyl Chloride	6,760	317	350	6,727
High Density Polyethylene	6,085	58	702	5,441
Polypropylene	4,940	13	848	4,105
Polystyrene	3,838	20	84	3,774
Phenolic	2,502	36	39	2,499
Styrene Copolymers (inc. ABS)	2,226	119	182	2,163
Urea	1,199	22	6	1,215
Unsaturated Polyester	1,232	7	39	1,200
Thermoplastic Polyester*	899	25	155	769
Nylon	396	36	59	373
Epoxy	406	11	95	322
Melamine	210	1	17	194
Other Vinyls	187	18	68	137
Total of these resins	39,293	899	3,484	36,708
1983 Total	37,145	581	3,767	33,959
1982 Total	31,262	268	4,102	27,428
1981 Total	33,696	307	3,596	30,407
1980 Total	31,247	247	4,194	27,300
1979 Total	34,550	273	3,625	31,198
1978 Total	31,101	234	2,302	29,033
1977 Total	28,077	136	1,978	26,235
1976 Total	25,565	135	2,185	23,515

*Not included in total 1976–1979.

Source: Production—SPI Monthly Statistical Report, as compiled by Ernst & Whinney.
Imports—Bureau of the Census, IM 146
Exports—Bureau of the Census, EM 546

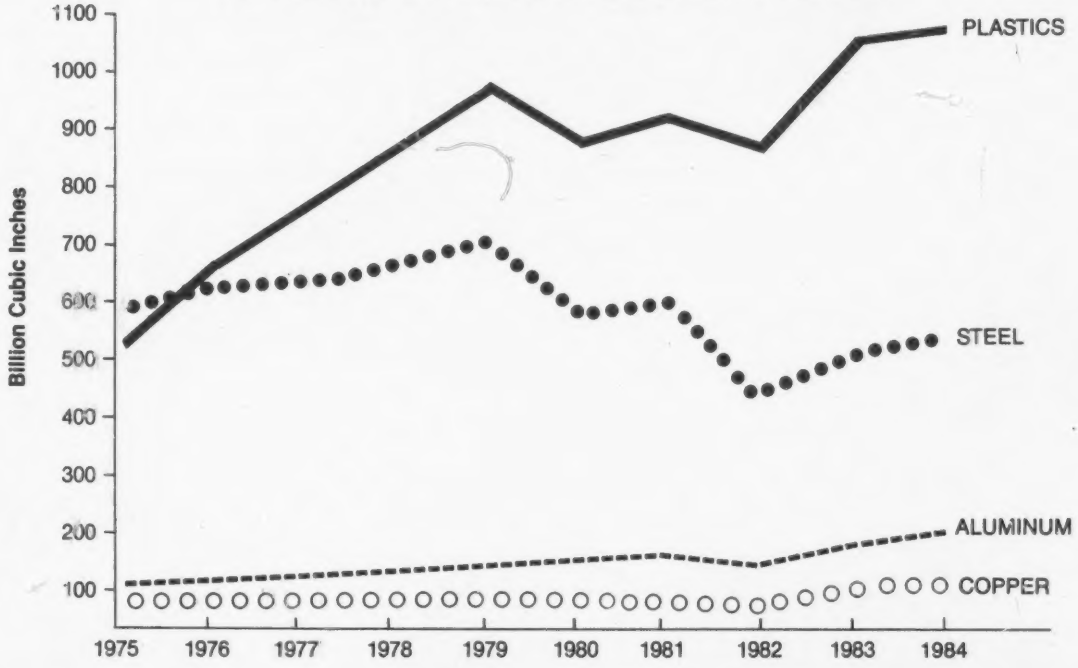
PLASTICS MATERIALS & RESINS
VALUE OF SHIPMENTS
(in millions of dollars)

VERSUS LARGEST CHEMICAL CATEGORIES	1980	1981	1982	1983	1984	COMPOUND GROWTH RATE 1979–1984
Industrial Organic Chemicals	34,800	38,500	30,250	35,550	43,650	5.9%
Drugs	19,900	22,300	24,700	26,850	29,900	11.6%
Plastics Materials & Resins	**14,900**	**16,700**	**15,750**	**17,150**	**18,700**	**5.5%**
Industrial Inorganic Chemicals	12,100	12,800	12,150	13,400	15,250	7.6%
Paints & Allied Products	8,350	9,150	9,250	10,450	12,050	5.4%
Toilet Preparations	7,850	8,700	10,100	11,000	11,850	9.9%
Soaps & Detergents	8,300	9,100	9,150	10,000	10,150	8.0%
Cyclic Crudes & Intermediates	7,600	8,050	7,300	8,200	9,000	7.5%
Fertilizers	7,950	8,000	7,300	6,700	7,800	4.9%
Polishes & Sanitation Goods	4,100	4,750	4,600	4,850	5,100	6.6%

VERSUS OTHER COMMODITIES	1980	1981	1982	1983	1984	COMPOUND GROWTH RATE 1979–1984
Steel Mill Products	60,250	68,950	46,100	42,850	45,600	– 8.2%
Paper and Board	28,700	32,000	30,900	33,850	39,100	9.0%
Cement and Concrete	18,000	17,950	16,550	18,350	21,550	3.5%
Plastics Materials & Resins	**14,900**	**16,700**	**15,750**	**17,150**	**18,700**	**5.5%**
Primary Aluminum	7,000	6,500	5,050	6,300	5,900	0.5%
Synthetic Rubber	2,650	3,000	3,150	3,300	3,650	6.6%
Primary Copper	5,500	5,400	3,100	3,000	2,650	– 14.4%
Leather Tanning & Finishing	1,800	1,900	1,750	1,850	2,050	2.6%

Source: Department of Commerce estimates.

SHIPMENTS BY VOLUME: PLASTICS VS METALS



NOTE: Factors used in conversion—steel = .289 lbs/cu in
plastics = .04 lbs/cu in
aluminum = .098 lbs/cu in
copper = .321 lbs/cu in

NOTE: Plastics do not include polyurethane
SOURCE: American Iron and Steel Institute
SPI
U.S. Bureau of the Census

PLASTICS MATERIALS AND RESINS (SIC 2821)

(in millions of dollars except as noted)

ITEM	1980	1981	1982	1983[1]	1984[2]	1985[3]	AAG 1972–1984
Industry data							
Value of shipments	14,908	16,676	15,746	17,140	18,710	—	12.7%
Value of shipments (1972$)	4,969	5,329	5,114	5,455	5,811	6,150	2.2
Total employment (000)	58.8	57.7	54.7	54.2	56.3	—	0.3
Production workers (000)	36.6	35.8	32.7	32.4	34.3	—	– 0.2
Average hourly earnings ($)	9.73	10.77	11.73	12.61	13.32	—	8.5
Product data							
Value of shipments	18,014	20,172	17,408	19,300	21,250	—	13.8
Value of shipments (1972$)	5,851	6,320	5,546	5,998	6,443	6,830	3.1
(1972=100)	307.9	319.1	314.0	321.8	329.8	—	10.6
Trade data							
Value of imports	263.4	315.7	292.0	507.5	748.6	895.0	24.0
Import/new supply rate	0.013	0.014	0.015	0.020	0.027	—	7.8
Value of exports	2,703	2,553	2,472	2,510	2,535	2,560	15.7
Export/shipment ratio	0.150	0.127	0.142	0.130	0.119	—	1.6

[1] Estimated except for shipments price index, exports and imports.
[2] Estimated.
[3] Forecast.

Source: U.S. Department of Commerce: Bureau of the Census, Bureau of Economic Analysis, and International Trade Administration (ITA). Estimates and forecasts by ITA.

MISCELLANEOUS PLASTICS PRODUCTS (SIC 3079)

(in millions of dollars except as noted)

ITEM	1980	1981	1982	1983[1]	1984[2]	1985[3]	AAG 1972–1984
Industry data							
Value of shipments	30,583	34,122	37,029	38,350	41,575	—	12.0%
Value of shipments (1972$)	14,977	15,761	16,672	16,932	17,691	18,225	4.3
Total employment (000)	470.1	469.5	479.2	510.1	591.1	—	4.5
Production workers (000)	368.9	369.5	369.1	397.7	469.8	—	2.5
Average hourly earnings ($)	5.80	6.20	6.98	7.34	7.61	—	7.3
Product data							
Value of shipments	30,271	34,152	37,552	38,350	41,575	—	11.6
Value of shipments (1972$)	14,824	15,775	16,908	16,932	17,691	18,225	4.0
(1972=100)	212.1	225.2	232.8	237.2	247.5	—	7.8
Trade data							
Value of imports	877.0	1,010	1,084	1,342	1,868	1,900	18.1
Value of exports	1,750	1,960	1,881	1,948	2,160	2,200	15.6

[1] Estimated except for shipments price index, exports and imports.
[2] Estimated.
[3] Forecast.

Source: U.S. Department of Commerce: Bureau of the Census, Bureau of Economic Analysis, and International Trade Administration (ITA). Estimates and forecasts by ITA.

GENERAL ECONOMIC STATISTICS

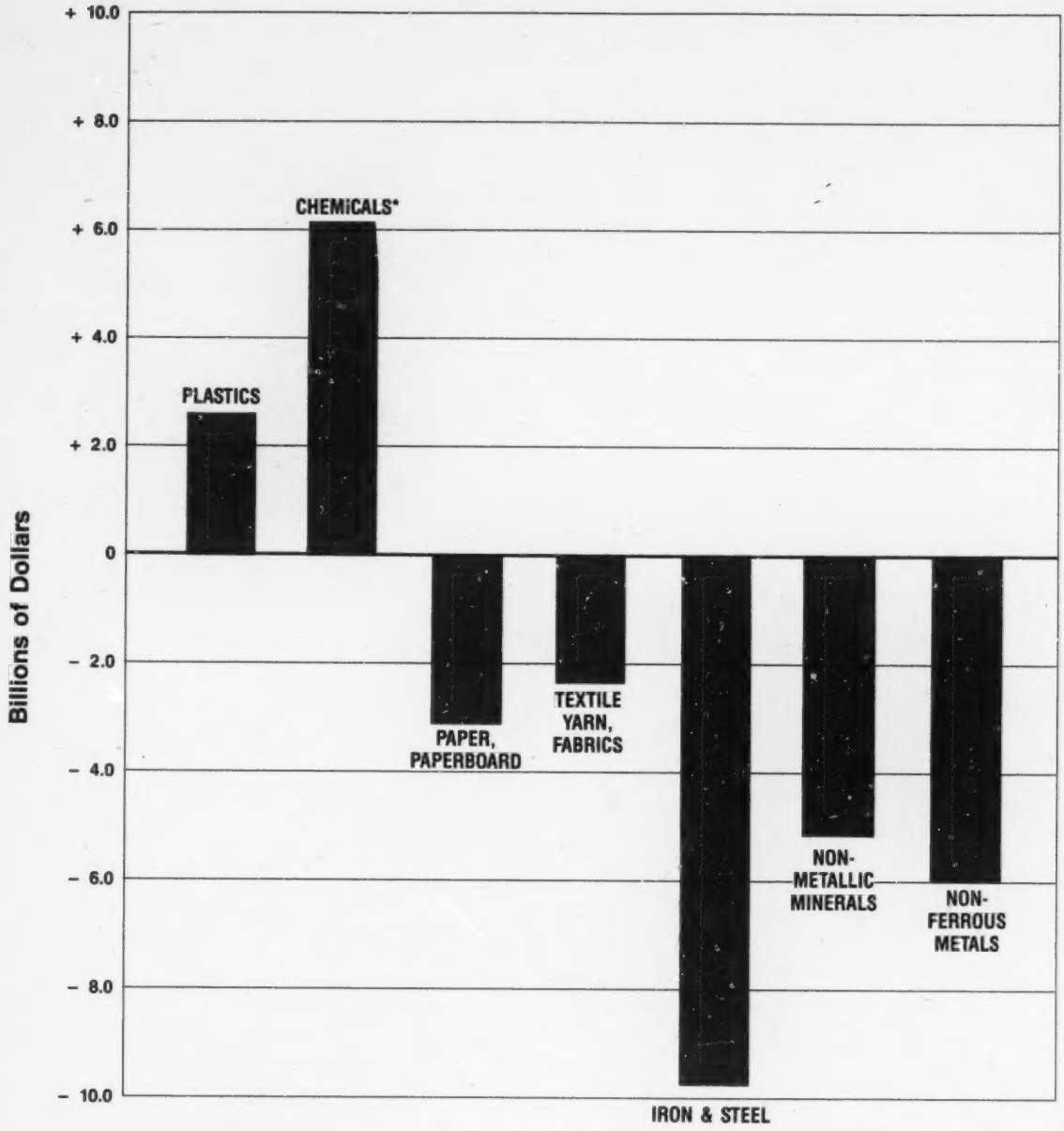
COMMODITY — BALANCE OF TRADE

(in millions of dollars)

	EXPORTS	IMPORTS	DIFFERENCE
Plastics Materials & Resins			
1980	3,884	652	+3,232
1981	3,809	779	+3,030
1982	3,650	766	+2,884
1983	3,732	1,098	+2,634
1984	4,050	1,477	+2,573
Chemicals (except plastics)			
1980	16,356	7,891	+8,465
1981	17,378	8,543	+8,835
1982	16,240	8,727	+7,513
1983	16,019	9,681	+6,338
1984	18,286	12,121	+6,165
Paper, Paperboard			
1980	2,831	3,534	− 703
1981	2,961	3,822	− 861
1982	2,653	3,848	−1,195
1983	2,553	4,215	−1,662
1984	2,620	5,571	−2,951
Textile, Yarn, Fabrics			
1980	3,632	2,504	+1,128
1981	3,619	3,043	+ 576
1982	2,784	2,807	− 23
1983	2,368	3,225	− 857
1984	2,382	4,475	−2,093
Iron and Steel			
1980	3,122	7,509	−4,387
1981	2,880	11,238	−8,358
1982	1,804	4,487	−2,683
1983	1,478	6,791	−5,313
1984	1,348	10,844	−9,496
Nonmetallic Minerals, n.e.c.			
1980	2,209	4,680	−2,471
1981	2,194	4,890	−2,696
1982	2,168	9,612	−7,444
1983	1,770	5,330	−3,560
1984	1,865	6,889	−5,024
Nonferrous Metals			
1980	4,743	7,612	−2,869
1981	2,594	6,947	−4,353
1982	2,094	5,320	−3,226
1983	2,033	7,422	−5,389
1984	2,028	8,001	−5,973

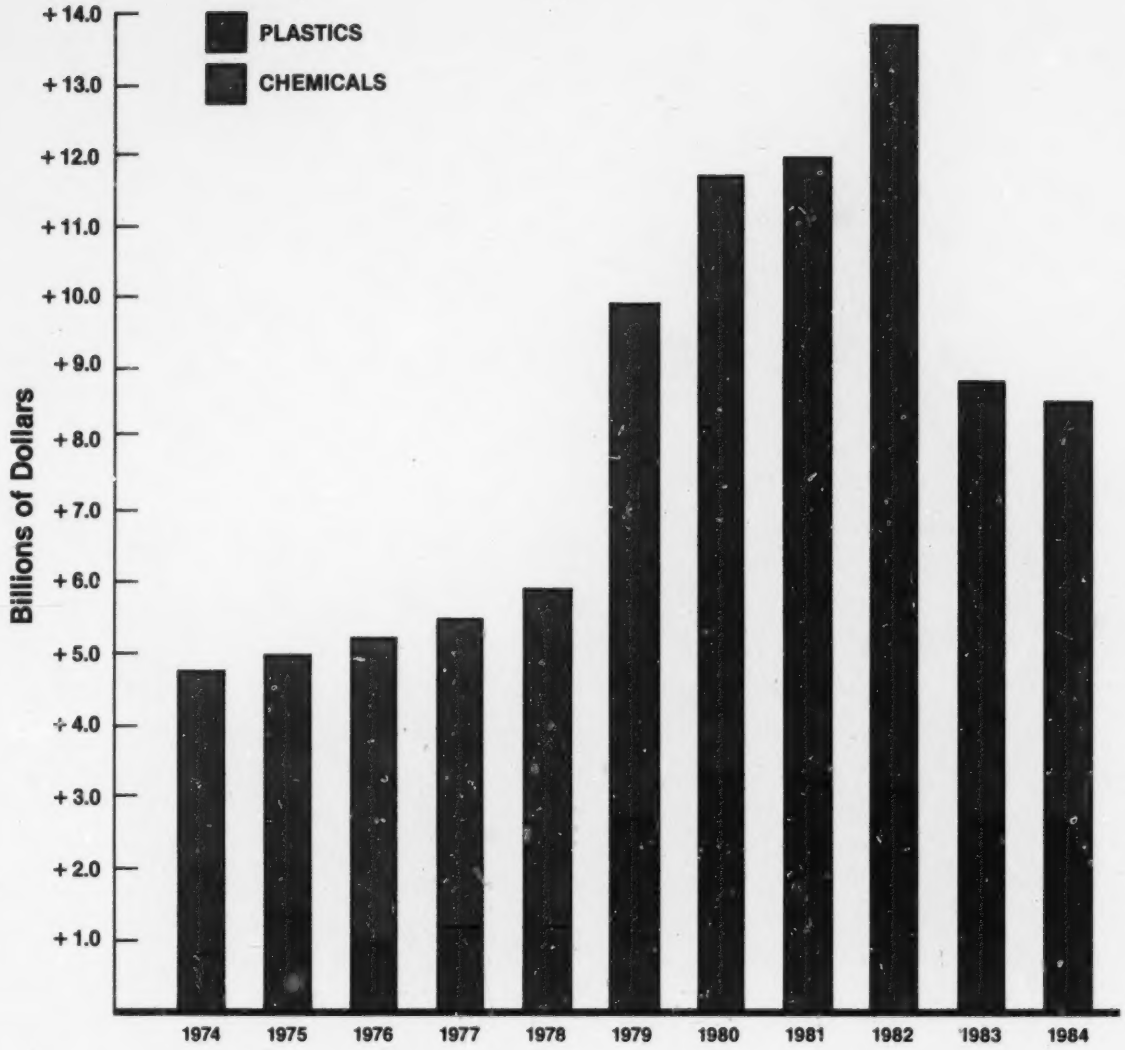
Source: U.S. Dept. of Commerce; FT 135(U.S. Imports), FT 410(U.S. Exports)

U.S. BALANCE OF TRADE—1984



Source: Department of Commerce
*Chemicals exclude plastics

PLASTICS & CHEMICALS BALANCE OF TRADE 1974-1984



PRODUCER PRICE INDEXES
[1967 = 100]

YEAR	COMMODITY GROUP					
	NON-METALLIC MINERAL PRODUCTS	METALS & METAL PRODUCTS	INDUSTRIAL COMMODITIES	CHEMICALS & ALLIED PRODUCTS	PLASTICS RESINS & MATERIALS	PULP, PAPER & ALLIED PRODUCTS
1968	103.7	102.6	102.5	99.8	91.9	101.1
1969	107.7	108.5	106.0	99.9	90.4	104.0
1970	113.3	116.7	110.0	102.2	90.7	108.2
1971	122.4	119.0	114.0	104.2	88.9	110.1
1972	126.1	123.5	117.9	104.2	88.7	113.4
1973	130.2	132.8	125.9	110.0	92.1	122.1
1974	153.2	171.9	153.8	146.8	143.8	151.7
1975	174.0	185.6	171.5	181.3	180.9	170.4
1976	186.3	195.9	182.4	187.2	194.0	179.4
1977	200.5	209.0	195.1	192.8	197.5	186.4
1978	228.8	227.1	209.4	198.8	199.9	195.6
1979	248.6	259.3	236.5	222.3	235.9	219.0
1980	282.9	286.4	274.3	260.3	279.5	249.2
1981	309.5	300.4	304.1	287.7	289.2	273.8
1982	318.6	302.0	312.4	292.3	283.3	288.7
1983	325.3	307.1	315.8	292.9	290.2	297.7
1984	337.2	316.0	310.3	300.9	308.5	318.2

Source: Dept. of Labor, Bureau of Labor Statistics

PROFILE OF 50 BIGGEST MANUFACTURING INDUSTRIES

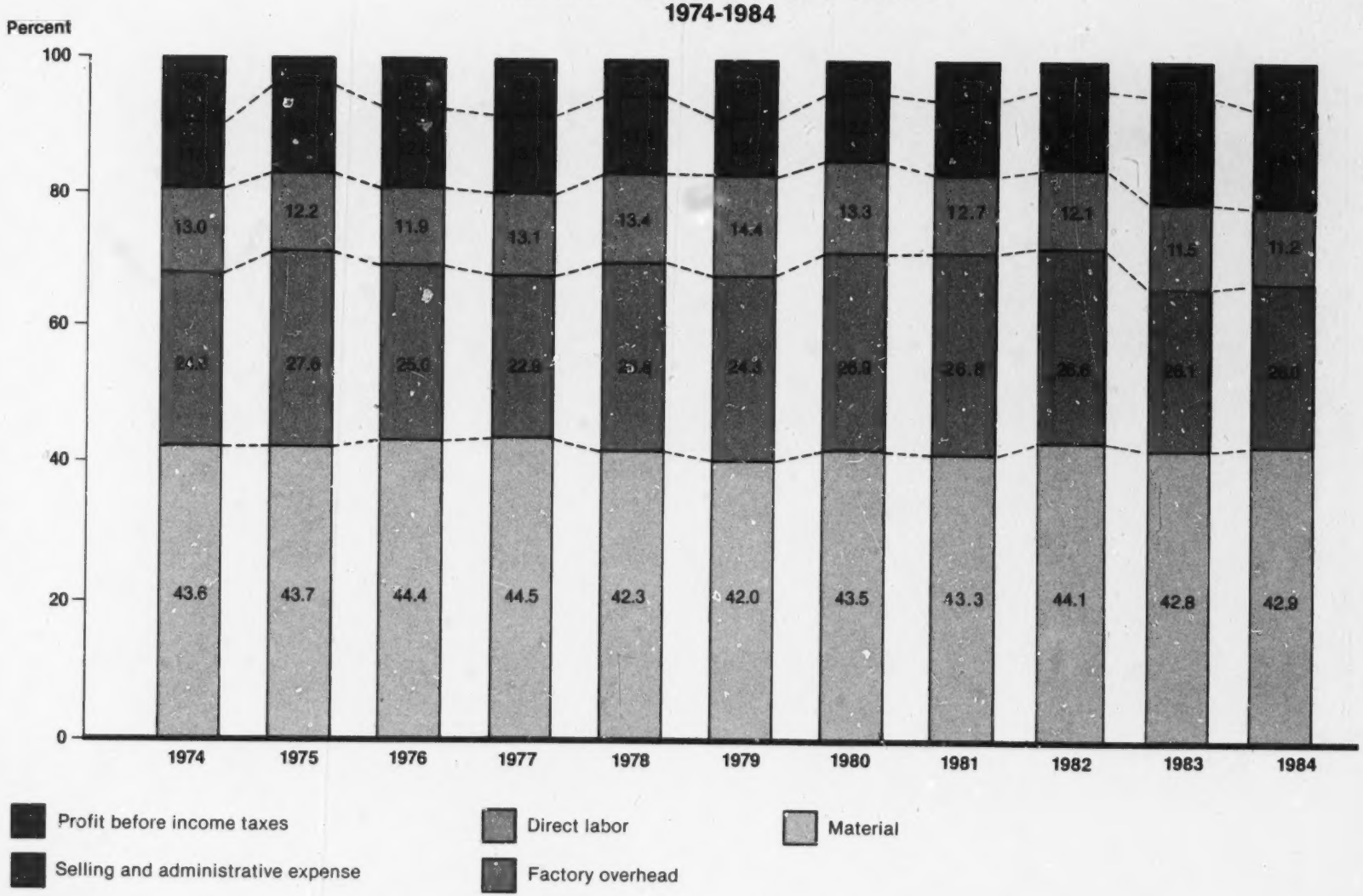
1984 RANK	SIC	INDUSTRY	1984 SHIPMENTS ($ MIL.)	TOTAL PLANTS	AVERAGE SHIPMENTS PER PLANT ($000)
1	2911	Petroleum refining	$187,314	371	$504,890
2	3711	Motor vehicles & car bodies	128,619	196	656,220
3	3714	Motor-vehicle parts & accessories	54,136	1,287	42,064
4	3573	Electronic computing equipment	46,273	1,269	36,464
5	2011	Meat-packing plants	45,894	1,026	44,731
6	3312	Blast furnaces & steel mills	44,101	380	116,055
7	2869	Industrial organic chemicals, N.E.C.	42,063	560	75,112
8	3662	Radio & TV communication equipment	37,280	1,310	28,458
9	3721	Aircraft	34,388	128	268,653
10	**3079**	**Miscellaneous plastics products**	**30,994**	**5,250**	**5,904**
11	2711	Newspapers	24,139	2,676	9,021
12	2621	Paper mills, except bldg. paper	23,968	357	67,138
13	**2821**	**Plastic materials & resins**	**20,624**	**502**	**41,083**
14	3861	Photographic equip. & supplies	19,821	433	45,776
15	2834	Pharmaceutical preparations	19,082	507	37,637
16	3661	Telephone & telegraph apparatus	18,256	265	68,891
17	2086	Bottled & canned soft drinks	17,479	1,665	10,498
18	2026	Fluid milk	17,349	989	17,541
19	2752	Commercial printing, lithographic	16,743	2,057	8,139
20	3724	Aircraft engines & engine parts	16,442	178	92,370
21	3679	Electronic components, N.E.C.	15,743	1,859	8,468
22	3674	Semiconductors & related devices	14,832	405	36,622
23	2111	Cigarettes	14,481	10	1,448,140
24	3585	Refrigeration & heating equipment	14,364	576	24,938
25	3531	Construction machinery	13,976	543	25,739
26	2819	Industrial inorganic chem., N.E.C.	13,690	637	21,491
27	2051	Bread, cake, & related products	13,475	1,417	9,509
28	2421	Sawmills & planing mills, general	13,138	2,040	6,440
29	2631	Paperboard mills	12,703	202	62,887
30	2082	Malt beverages	12,185	76	160,333
31	2824	Organic fibers, noncellulosic	12,036	56	214,934
32	2653	Corrugated & solid fiber boxes	11,985	1,133	10,578
33	3519	Internal combustion engines, N.E.C.	11,912	153	77,853
34	2721	Periodicals	11,385	974	11,689
35	3443	Fabricated plate work, boiler shops	11,128	1,351	8,237
36	3011	Tires and inner tubes	11,123	131	84,911
37	2013	Sausage & other prepared meats	11,049	810	13,641
38	2647	Sanitary paper products	10,487	110	95,337
39	3728	Aircraft equipment, N.E.C.	10,366	651	15,923
40	3761	Guided missiles & space vehicles	10,234	74	138,291
41	3599	Machinery, exc. electrical, N.E.C.	10,105	3,491	2,895
42	3494	Valves & pipe fittings	9,936	790	12,577
43	3465	Automotive stamping	9,902	202	49,020
44	2033	Canned fruits & vegetables	9,860	670	14,717
45	2099	Food preparations, N.E.C.	9,846	806	12,216
46	2022	Cheese, natural & processed	9,792	348	28,139
47	3533	Oil field machinery	9,709	478	20,311
48	3321	Gray iron foundries	9,646	770	12,527
49	3411	Metal cans	9,625	336	28,644
50	3441	Fabricated structural metal	9,590	1,830	5,241
		50-industry total	$1,193,268	44,335	$26,915

n.e.c.: not elsewhere classified.

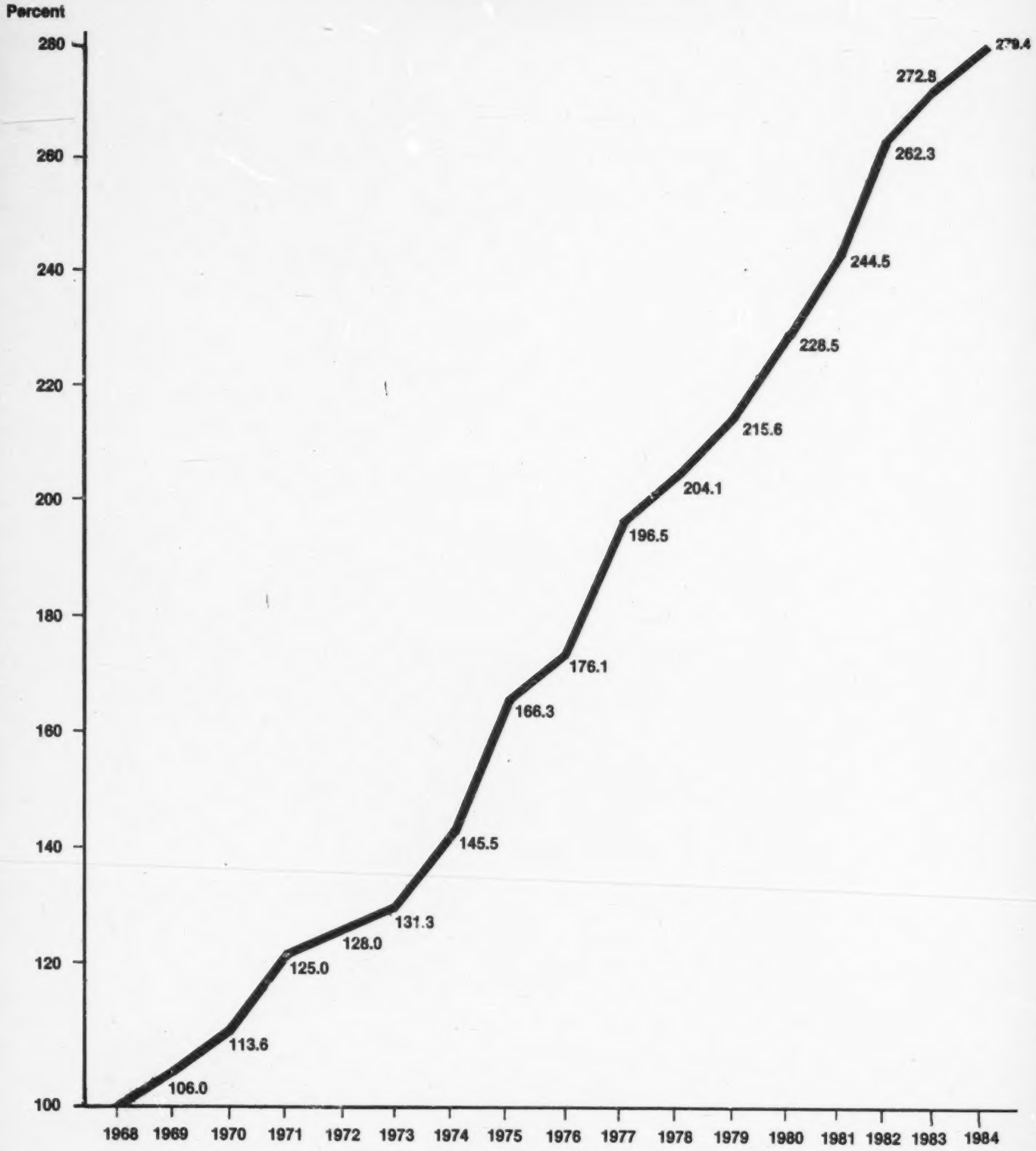
Definitions: Shipments: Output of all manufacturing plants. No. of Plants: Manufacturing establishments with 20 or more employees.

Sources: *Sales & Marketing Management's 1985 Survey of Industrial & Commercial Purchasing Power.*

TREND IN DISTRIBUTION OF SALES DOLLAR
PLASTICS PROCESSING COMPANIES
1974-1984



PLASTICS PROCESSING COMPANIES
TREND IN STRAIGHT-TIME HOURLY WAGES
1968-1984 (1968 = 100)



SALES OF MAJOR U.S. PLASTICS PRODUCING COMPANIES

(rounded to nearest $25 million)

COMPANY[3]	PLASTICS SALES[1]		CHEMICALS SALES[2]		TOTAL SALES	
	1984	1983	1984	1983	1984	1983
1. Du Pont	3,875	3,500	8,100	7,575	35,925	35,375
2. Dow Chemical	3,750	3,500	7,800	7,675	11,425	10,950
3. Exxon	1,650	1,500	6,875	6,400	95,875	93,450
4. Mobil Oil	1,150	1,025	2,750	2,425	60,475	59,000
5. Union Carbide	1,100	1,000	3,200	3,200	9,500	9,000
6. Standard Oil (Indiana)	950	825	2,950	3,025	29,000	29,500
7. B.F. Goodrich	900	850	1,425	1,325	3,450	3,200
8. Monsanto	875	800	2,825	2,675	6,700	6,300
9. Shell Oil	800	700	3,300	3,125	20,900	19,875
10. W.R. Grace	775	700	2,850	2,750	6,725	6,225
11. Hercules	725	650	1,875	1,700	2,575	2,625
12. Chevron Oil	700	n.a.	1,100	1,050	29,200	29,175
13. Celanese	675	650	1,625	1,550	3,325	3,250
14. Phillips Petroleum	650	575	2,350	2,250	15,750	15,400
15. Atlantic Richfield	525	425	3,150	2,875	25,225	25,300
16. Borg Warner	475	450	950	825	3,925	3,550
17. General Electric	450	425	450	425	27,950	26,800
Reichhold Chemicals	450	425	725	650	800	750
19. Rohm and Haas	425	400	1,950	1,800	2,050	1,875
20. National Distillers	400	300	1,075	775	2,250	1,950
21. Eastman Kodak	350	300	2,450	2,275	10,600	10,175
Certain Teed	350	300	350	300	1,200	1,050
23. Goodyear Tire & Rubber	325	300	750	700	10,250	9,750
Allied Corp.	325	300	2,425	2,325	10,725	9,900
25. Ethyl	300	450	1,350	1,475	1,675	1,750
26. Upjohn	275	250	325	300	2,175	1,975
27. Tenneco	250	250	1,850	1,800	14,900	14,450
U.S. Steel	250	225	1,375	1,150	19,100	17,550
Borden	250	200	1,450	1,300	4,575	4,275
30. Owens-Corning Fiberglas	225	200	225	200	3,025	2,750
31. Occidental Petroleum	200	250	975	1,125	15,575	19,125
32. Georgia-Pacific	175	150	250	200	6,675	6,050

Note: There are several domestic and foreign-based companies which could be listed above had data been available such as Mobay, American Hoechst, Ciba-Geigy, Soltex Polymer, et al.

n.a.=not available

[1] Includes fabricated plastics products.

[2] Includes plastics.

[3] Ranked by plastics sales in 1984.

Source: Company annual reports, industry estimates.

U.S. PLASTICS RESIN PLANT LOCATIONS

U.S. PLASTICS PROCESSING PLANT LOCATIONS

TOP 10 STATES OF THE PLASTICS INDUSTRY—1982*

NUMBER OF ESTABLISHMENTS[1]

1. California	2,731
2. New York	1,444
3. Illinois	1,324
4. Ohio	1,233
5. New Jersey	1,209
6. Michigan	1,079
7. Texas	913
8. Pennsylvania	904
9. Massachusetts	837
10. Florida	662

NUMBER OF EMPLOYEES[2]

1. Ohio	86,300
2. California	79,000
3. Illinois	73,000
4. New Jersey	60,100
5. New York	52,100
6. Michigan	51,800
7. Pennsylvania	45,400
8. Massachusetts	40,600
9. Texas	35,700
10. Indiana	34,000

VALUE OF SHIPMENTS[3] ($MILLION)

1. Ohio	$7,902
2. California	6,680
3. Illinois	6,266
4. New Jersey	5,938
5. Texas	5,877
6. Michigan	4,131
7. Pennsylvania	4,079
8. New York	3,917
9. Massachusetts	3,434
10. Indiana	3,039

NEW CAPITAL EXPENDITURES ($ MILLION)

1. Texas	$523
2. Ohio	349
3. Illinois	274
4. California	260
5. Michigan	224
6. New Jersey	190
7. Pennsylvania	149
8. New York	136
9. So. Carolina	135
10. Massachusetts	131

PAYROLL ($ MILLION)

1. Ohio	$1,512
2. California	1,302
3. Illinois	1,233
4. New Jersey	1,043
5. Michigan	951
6. New York	840
7. Pennsylvania	789
8. Massachusetts	680
9. Texas	636
10. Indiana	582

*The plastics industry includes establishments producing resins, machinery, fabricated products, and molds.

[1] A company operating at more than one location is required to file a separate report for each location (establishment)

[2] Includes all employees, administrative and manufacturing.

[3] Covers the received or receivable net selling values, f.o.b. plant (exclusive of freight and taxes), of all products shipped, both primary and secondary, as well as all miscellaneous receipts, such as receipts for contract work performed for others, installation and repair, sales of scrap, and sale of products bought and resold without further processing.

Source: Dept. of Commerce, Bureau of the Census
SPI estimates

PLASTICS PROCESSING INDUSTRY BY SALES GROUPS—1984

SALES LESS THAN $5 MILLION			Operating Statements	SALES $5-$10 MILLION		
Less Profitable	Median	More Profitable		Less Profitable	Median	More Profitable
100.0	100.0	100.0	Net Sales	100.0	100.0	
1.3	1.1	0.9	Less Adjustments & Allowances	1.0	1.4	1.7
98.6	98.9	99.1	Net Sales	99.0	98.6	98.3
43.0	41.0	38.5	Direct Materials	50.8	44.3	37.6
12.3	12.2	12.0	Direct Labor	10.9	10.7	10.5
6.8	6.4	5.9	Indirect Labor	6.1	7.5	9.0
3.3	3.1	2.9	Utilities	3.2	2.8	2.3
3.0	3.0	2.9	Depreciation	2.3	2.4	2.4
11.9	11.6	11.3	Other Mfg. Expense	9.1	10.4	11.6
0.2	0.8	1.3	Net on Tool Transactions	(0.3)	0.1	0.4
5.3	4.3	3.3	Selling Expenses	4.8	4.6	4.4
10.4	11.1	11.8	Administrative Expense	8.2	7.9	7.0
2.5	5.4	9.2	Operating Earnings	3.9	7.9	13.1
0.7	0.8	0.8	Other Income or (Expense)	1.2	1.3	2.3
1.8	4.6	8.4	Profit Before Income Taxes	2.7	6.6	10.8
0.6	1.5	3.4	Income Taxes	0.8	2.1	4.3
1.2	3.1	6.0	PROFIT AFTER INCOME TAXES	1.9	4.3	6.5
153.0%	159.6%	166.2%	Sales as Percentage of Total Assets	226.0%	211.5%	197.0%
			Balance Sheets			
1.8	5.4	8.9	Cash	1.8	4.2	6.6
26.0	26.0	26.0	Accounts & Notes Receivable	29.6	29.8	30.0
18.2	18.0	17.3	Inventory	19.2	21.5	23.8
1.8	1.8	1.0	Other Current Assets	1.6	1.3	1.0
47.8	51.2	53.2	CURRENT ASSETS	52.2	56.8	61.4
21.5	26.7	27.9	Land & Buildings, at Cost	20.2	18.8	17.5
5.9	6.9	7.8	Depreciation Reserve	4.7	4.7	4.8
65.6	55.3	48.3	Machinery & Equipment, at Cost	61.7	51.7	41.7
34.0	30.5	26.8	Depreciation Reserve	32.9	26.2	19.6
3.3	4.2	5.2	Other Long-Term Assets	3.5	3.6	3.8
100.0	100.0	100.0	TOTAL ASSETS	100.0	100.0	100.0
4.6	4.4	4.1	Current Portion of Term Debt	5.0	3.4	1.7
25.9	24.8	23.7	Notes Payable	11.0	9.3	7.5
18.2	17.3	16.4	Accounts Payable, Trade	15.6	12.5	9.4
7.3	7.7	8.1	Other Payables & Accruals	5.8	7.4	9.1
56.0	54.2	52.3	CURRENT LIABILITIES	37.4	32.6	27.7
10.9	10.5	10.1	Other Long-Term Debt	16.7	11.5	6.2
66.9	64.7	62.4	TOTAL LIABILITIES	54.1	44.1	33.9
33.1	35.3	37.6	EQUITY (NET WORTH)	45.9	55.9	66.1
			Statistical Data			
19.0%	24.1%	29.6%	Percent Change in Sales, '84 vs '83	22.0%	19.0%	16.0
53.2	52.5	51.1	Cost of Sales/Inventory	37.2	46.7	58.7
62.0	59.5	57.1	Average Collection Period	47.8	51.4	55.6
2.8%	7.3%	14.0%	Profit Before Income Taxes/Assets	6.1%	14.0%	21.3%
5.5%	14.0%	26.5%	Net Income/Equity	9.4%	16.3%	19.4%

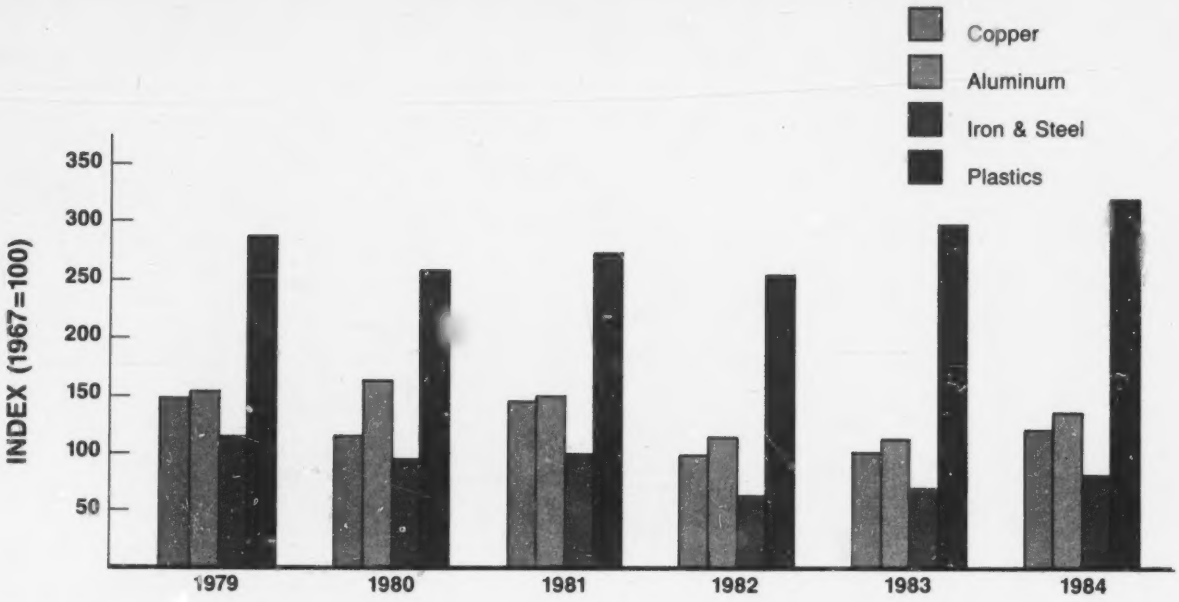
Source: SPI Financial and Operating Ratios Survey No. 23—1984

PLASTICS PROCESSING INDUSTRY BY SALES GROUPS—1984

SALES $10 MILLION OR MORE			
Less Profitable	Median	More Profitable	Operating Statements
100.0	100.0	100.0	Net Sales
2.0	1.7	1.3	Less Adjustments & Allowances
98.0	98.3	98.7	Net Sales
41.2	42.4	44.2	Direct Materials
13.3	11.2	9.8	Direct Labor
9.2	9.5	9.9	Indirect Labor
3.6	3.3	2.9	Utilities
3.3	3.0	2.8	Depreciation
10.5	7.6	5.4	Other Mfg. Expense
0.3	0.2	0.1	Net on Tool Transactions
4.9	5.3	5.8	Selling Expenses
7.4	7.1	6.7	Administrative Expense
4.3	8.7	11.1	Operating Earnings
1.6	1.2	0.5	Other Income or (Expense)
2.7	7.5	10.6	Profit Before Income Taxes
0.9	3.2	4.6	Income Taxes
1.8	4.3	6.0	PROFIT AFTER INCOME TAXES
190.0%	186.3%	182.6%	Sales as Percentage of Total Assets
			Balance Sheets
0.9	2.0	2.5	Cash
22.9	23.1	23.8	Accounts & Notes Receivable
15.5	17.7	19.8	Inventory
3.2	2.2	1.1	Other Current Assets
42.5	45.0	47.2	CURRENT ASSETS
28.9	25.5	22.0	Land & Buildings, at Cost
8.7	6.9	5.1	Depreciation Reserve
65.9	62.8	58.4	Machinery & Equipment, at Cost
33.4	29.9	24.9	Depreciation Reserve
4.8	3.5	2.4	Other Long-Term Assets
100.0	100.0	100.0	TOTAL ASSETS
5.4	3.5	1.4	Current Portion of Term Debt
6.7	6.9	7.1	Notes Payable
10.8	9.7	8.6	Accounts Payable, Trade
8.6	10.7	12.7	Other Payables & Accruals
31.5	30.8	29.8	CURRENT LIABILITIES
23.9	18.7	13.5	Other Long-Term Debt
55.4	49.5	43.3	TOTAL LIABILITIES
44.6	50.5	56.7	EQUITY (NET WORTH)
			Statistical Data
17.0%	18.9%	25.2%	Percent Change in Sales, '84 vs '83
35.8	44.1	51.0	Cost of Sales/Inventory
44.0	45.3	47.6	Average Collection Period
5.1%	14.0%	19.4%	Profit Before Income Taxes/Assets
7.7%	15.9%	19.3%	Net Income/Equity

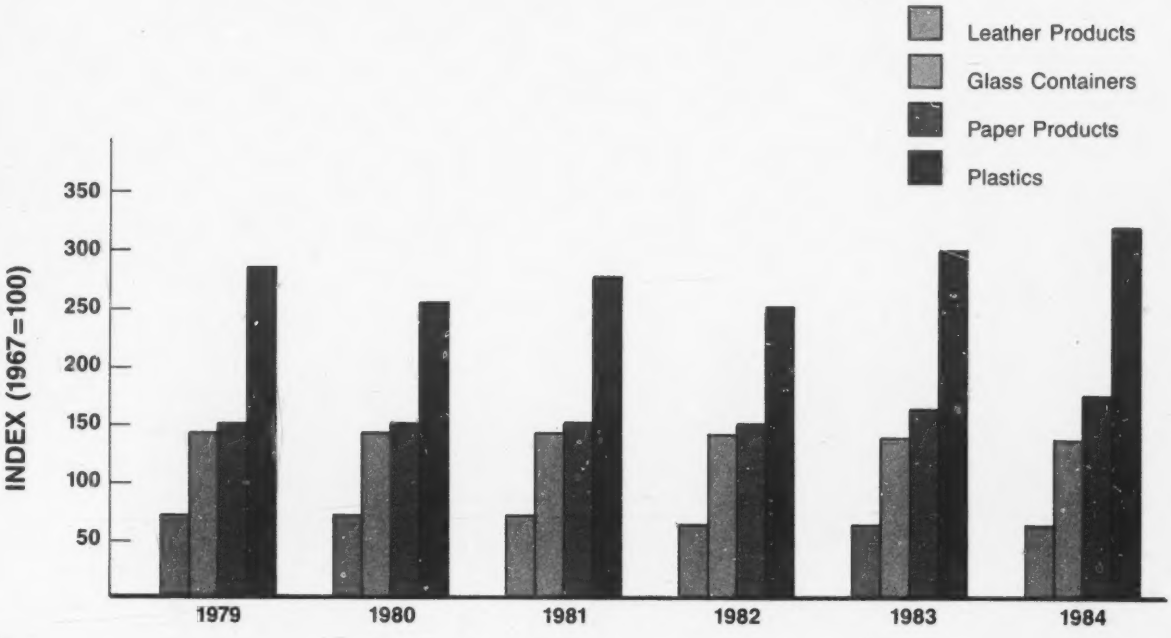
Source: SPI Financial and Operating Ratios Survey No. 23—1984

PLASTICS PRODUCTION vs COMPETITIVE MATERIALS



Source: SPI
Survey of Current Business

PLASTICS PRODUCTION vs COMPETITIVE PRODUCTS



Source: SPI
Survey of Current Business

FEEDSTOCKS & ADDITIVES

PLASTICS DERIVED FROM MAJOR FEEDSTOCKS*

(In millions of pounds)

FEEDSTOCK	Total Production		Plastics Derivatives		Plastics % of Total	
	1984	1983	1984	1983	1984	1983
Ethylene	31,175	28,600	20,805	19,455	67	68
Propylene	13,680	12,600	7,450	6,760	54	54
Benzene	9,800	9,425	7,305	6,615	75	70

* These data should not be construed to represent the entire feedstock needs of the U.S. plastics industry. They are based on 1983 and 1984 plastics production only and do not include feedstock needs for monomers, additives, and other chemicals not used in domestic production.

PLASTICS CONSUMPTION OF FEEDSTOCKS—1984

(millions of pounds)

Ethylene	Styrene Butadiene Latex	190	0.9%
	Styrene Acrylonitrile	25	0.1
	Acrylonitrile Butadiene Styrene	205	1.0
	Polyvinyl acetate	275	1.3
	Polyethylene	15,225	73.2
	Polystyrene	1,310	6.3
	Other Styrenes	75	0.4
	Polyvinyl chloride	3,500	16.8
		20,805	100.0%
Propylene	Epoxy	160	2.1%
	Phenolic	1,190	16.0
	Polypropylene	5,435	73.0
	Polyester	270	3.6
	Styrene Acrylonitrile	40	0.5
	Acrylonitrile Butadiene Styrene	355	4.8
		7,450	100.0%
Benzene	Acrylonitrile Butadiene Styrene	555	7.6%
	Styrene Acrylontrile	65	1.0
	Styrene Butadiene Latex	440	6.0
	Polystyrene	3,500	47.9
	Other Styrenes	205	2.8
	Epoxy	275	3.8
	Polyester	280	3.8
	Nylon	565	7.7
	Phenolic	1,420	19.4
		7,305	100.0%

SELECTED PLASTICS PRECURSORS

PRECURSOR	Total Production		Plastics Derivatives		Plastics % of Total	
	1984	1983	1984	1983	1984	1983
Acrylonitrile	2,200	2,145	265	230	12	11
Bisphenol A	760	645	535	450	70	70
Butadiene	2,530	2,315	580	500	23	22
Cyclohexane	2,130	1,690	450	365	21	22
Formaldehyde	5,715	5,400	4,780	4,470	84	83
Maleic Anhydride	360	300	200	175	56	58
Phenol	2,845	2,610	2,150	2,100	76	80
Phthalic Anhydride	870	850	550	495	63	58
Styrene	7,700	6,985	5,865	5,175	76	74
Vinyl Acetate	2,025	1,960	2,025	1,960	100	100
Vinyl Chloride	7,515	6,950	7,515	6,950	100	100

Source: U.S. International Trade Commission, SRI International, Society of the Plastics Industry estimates

ADDITIVES FOR PLASTICS

ADDITIVE LUBRICANTS

These materials are added to plastics to assist flow in calendering, molding and extrusion by lubricating the metal surfaces in contact with the plastic. They also assist in knitting and wetting of the resin in mixing and milling operations. To be effective, lubricants must be compatible with the resins in which they are used, must not adversely affect the properties of end-products, and must be easily combined.

Examples: stearic acid, waxes, fatty acid esters, fatty acid amines.

ANTIOXIDANTS

They inhibit the oxidation of materials exposed to air or oxygen at normal or elevated temperatures. They are used in plastics which are subject to oxidative degradation, such as polyolefins, ABS, polystyrene, acetal and polyphenylene oxide.

Examples: alkylated phenols, amines, organic phosphites and phosphates, esters.

ANTISTATS

Chemicals which impart a slight to moderate degree of electrical conductivity to plastics compounds, thus preventing the accumulation of electrostatic charges on finished articles. They may be incorporated in the materials before molding, or applied to their surfaces after molding. They function either by being inherently conductive or by absorbing moisture from the air.

Examples: quaternary ammonium compounds, anionics, amines.

BLOWING AGENTS [FOAMING AGENTS]

Substances which alone or in combination with other substances are capable of producing a cellular structure in a plastic or rubber mass. Thus, the term includes compressed gases which expand when pressure is released, soluble solids that leave pores when leached out, liquids that develop cells when they change to gases, and chemical agents that decompose or react under the influence of heat to form a gas.

Examples: azodicarbonamide, modified azos, OBSH, HTBA.

COLORANTS

Dyes or pigments which impart color to plastics. The dyes are synthetic or natural compounds of submicroscopic or molecular size, soluble in most common solvents, yielding perfectly transparent colors. The pigments are organic and inorganic substances with larger particle sizes and usually insoluble in the common solvents. Colorants are added to plastics by dry coloring (tumbling the colorant with the base or compounded resin); by extrusion coloring (extruding a dry colored mixture and chopping it into pellets to be reprocessed); by masterbatching; or by stirring colorants or dispersions thereof into liquid plastisols or resin systems.

Examples: titanium dioxide, iron oxides, anthraquinones, carbon black.

FLAME RETARDANTS

Materials that reduce the tendency of plastic articles to burn. They are usually incorporated as additives during compounding, but sometimes are applied to surfaces of finished articles.

Examples: antimony trioxide, chlorinated paraffins, bromophenols.

HEAT STABILIZERS

Agents used in compounding some plastics to assist in maintaining the physical and chemical properties of the compounded materials at suitable values throughout the processing and service life of the material and/or the parts made therefrom. They protect plastics from the effects of heat such as changes in color, decrease in mechanical and electrical properties, and undesirable surface conditions.

Examples: lead, barium-cadmium, tin, calcium-zinc.

ORGANIC PEROXIDES

Thermally decomposable compounds which can initiate polymerization reactions and effect cross-linking upon decomposition. The rate of decomposition can be controlled by means of promoters or accelerators added to the system to increase the decomposition rate; or by inhibitors when it is desired to retard the decomposition.

Examples: MEK peroxide, benzoyl peroxide, alkyl peroxide, peresters.

PLASTICIZERS

Materials incorporated in a plastic or elastomer to increase its flexibility, workability or distensibility. Most plasticizers are nonvolatile organic liquids or low-melting point solids, which function by reducing the normal intermolecular forces in a resin thus permitting the macromolecules to slide over one another more freely.

Examples: adipates, azelates, trimellitates, DOP/DIOP/DIDP.

ULTRAVIOLET STABILIZERS (UV LIGHT ABSORBERS)

Chemical agents which absorb or screen out radiation beyond the violet end of the spectrum of visible radiations. Such radiation has sufficient energy to initiate reactions leading to the degradation of many plastics. These agents are often combined with other additives, e.g. heat stabilizers and antioxidants, with which they act in synergistic fashion.

Examples: benzophenones, benzotriazole, salicylates.

Source: Whittington's Dictionary of Plastics

CONSUMPTION OF ADDITIVES

(in millions of pounds)

TYPE	1980	1981	1982	1983	1984
Additive Lubricants	77	88	83	85	91
Antioxidants	32	34	31	34	35
Antistats	5	6	6	6	n.a.
Blowing Agents	10	11	11	11	12
Colorants	307	331	320r	367r	392
Flame Retardants	475	420	378r	418r	453
Heat Stabilizers	83	86	78	81	85
Organic Peroxides	34	37	33	36r	38
Plasticizers	1,485	1,505	1,327r	1,445r	1,580
Ultraviolet Stabilizers	5	5	5	5	6

Source: Modern Plastics Magazine
r=revised from 1984 edition
n.a.=not available

DEFINITIONS OF PLASTICS

ACETAL

An engineering thermoplastic produced by the polymerization of purified formaldehyde [CH_2O] into both homopolymer and copolymer types. Typical applications are found in consumer products, automotive parts, and industrial machinery parts.

ACRYLICS

A family of thermoplastic resins of acrylic esters [$CH_2CHCOOR$] or methacrylic esters [$CH_2C(CH_3)COOR$]. The acrylates may be methyl, ethyl, butyl, or 2-ethylhexyl. Usual methacrylates are the methyl, ethyl, butyl, laural and stearyl. Typical applications are found in lighting fixtures, glazing and automotive parts.

ACRYLONITRILE BUTADIENE STYRENE

A class of thermoplastic terpolymers including a range of resins, all prepared with usually more than 50% styrene [$C_6H_5CHCH_2$] and varying amounts of acrylonitrile [CH_2CHCN] and butadiene [$CH_2CHCHCH_2$]. The three components are combined by a variety of methods involving polymerization, graft copolymerization, physical mixtures and combinations thereof. Typical applications are found in appliances, automotive parts, pipe, and business machine and telephone components.

ALKYDS

Thermosetting unsaturated polyester resins produced by reacting an organic alcohol with an organic acid, dissolved in and reacted with unsaturated monomers such as styrene [$C_6H_5CHCH_2$], diallyl phthalate [$C_6H_4(COOCH_2CHCH_2)_2$], diacetone acrylamide [$CH_3COCH_2C(CH_3)_2CHCHCONH_2$] or vinyl toluene [$CH_2CHC_6H_4CH_3$]. Typical applications are found in electrical uses, automotive parts, and as coatings.

CELLULOSICS

A family of thermoplastic resins manufactured by chemical modification of cellulose [$(C_6H_{10}O_5)_n$]. Included are: *cellophane*—regenerated cellulose made by mixing cellulose xanthate [ROCSSH] with a dilute sodium hydroxide [NaOH] solution to form a viscose, then extruding the viscose into an acid bath for regeneration; *cellulose acetate*—an acetic acid ester [$CH_3COOC_2H_5$] of cellulose; *cellulose acetate butyrate*—a mixed ester produced by treating fibrous cellulose with butyric acid [$CH_3CH_2CH_2COOH$], butyric anhydride [$(CH_3CH_2CH_2CO)_2O$], acetic acid [CH_3COOH] and acetic anhydride [$(CH_3CO)_2O$] in the presence of sulfuric acid [H_2SO_4]; *cellulose propionate*—formed by treating fibrous cellulose with propionic acid [$CH_3CH_2CO_2H$] and acetic acid and anhydrides in the presence of sulfuric acid; *cellulose nitrate*—made by treating fibrous cellulosic materials with a mixture of nitric [HNO_3] and sulfuric acids. Typical applications of cellulosics are found in packaging, consumer products, and automotive parts.

COUMARONE-INDENE

Thermoplastic resin obtained by heating mixtures of coumarone [C_6H_6O] and indene [$C_6H_4CH_2CHCH$] with sulfuric acid (H_2SO_4] to promote polymerization. These resins have no commercial applications when used alone. They are used primarily as processing aids, extenders and plasticizers with other resins in asphalt floor tile.

DIALLYL PHTHALATE(DAP)

The term DAP is used both for the monomeric and polymeric forms. The monomer [$C_6H_4(COOCH_2CHCH_2)_2$] is used as a cross-linking agent in unsaturated polyester resins. As a polymer, it is used in the production of thermosetting molding powders, casting resins and laminates.

EPOXY

Thermosetting resins, that, in the uncured form, contain one or more reactive epoxide or oxirane groups . These epoxide groups serve as cross-linking points in the subsequent curing step, in which the uncured epoxy is reacted with a curing agent or hardener. Cross-linking is accomplished through the epoxide groups as well as through hydroxyl groups that may be present. Most conventional unmodified epoxy resins are produced from epichlorohydrin (chloropropylene oxide) [CH_2OCHCH_2Cl] and bisphenol A [$(CH_3)_2C(C_6H_4OH)_2$]. The other types of epoxy resins are phenoxy resins, novolac resins, and cycloaliphatic resins. Epoxy resins are used as protective coatings, bonding adhesives, in building and construction, and electrical uses, plus many other uses.

FLUOROPOLYMERS

A family of thermoplastic resins analogous to polyethylene in which some of the hydrogen atoms attached to the carbon chain are replaced by fluorine or fluorinated alkyl groups. In some cases, other halogens such as chlorine are also part of the molecule. The most common commercial fluoropolymers are: *FEP* (fluorinated ethylene-propylene) from tetrafluoroethylene [C_2F_4] and hexafluoropropylene [C_3F_6]; *PTFE* (polytetrafluoroethylene) from the polymerization of tetrafluoroethylene and ethylene [C_2H_4]; *PFA* (perfluoroalkoxy) from tetrafluoroethylene and perfluoropropyl vinyl ether [$C_3H_7C_4OF_9$]; *PCTFE* (polychlorotrifluoro-ethylene) from chlorotrifluoro-ethylene monomer [C_2F_3Cl]; *CTFE-VDF* (polychlorotrifluoroethylenevinylidene fluoride) from chlorotrifluoroethylene and vinylidene fluoride [$C_2H_2F_2$]; *E-CTFE* (polyethylene-chlorotrifluoroethylene) from chlorotrifluoroethylene and ethylene; *PVDF* (polyvinylidene fluoride) from vinylidene fluoride monomer; and, *PVF* (polyvinyl fluoride) from vinyl fluoride monomer [C_2H_3F]. Typical applications for fluoropolymers are found in electrical/electronic uses and pipe and chemical processing equipment.

MELAMINE-FORMALDEHYDE

Thermosetting resins formed by the condensation reaction of formaldehyde [HCHO] and melamine [$C_3N_3(NH_2)_3$]. The chemistry is analogous to that of urea-formaldehyde except that the three amino groups of melamine provide more possibilities for cross-linking, are more highly reactive, and all six hydrogen atoms of melamine will react, forming the hexamethyl compound. Typical applications are found in bonding and adhesives, coatings, and consumer products.

NITRILE RESINS

Thermoplastic resins composed of acrylonitrile [CH_2CHCN], along with co-monomers such as acrylates, methacrylates, butadiene [$CH_2CHCHCH_2$] and styrene [$C_6H_5CHCH_2$]. Both straight copolymers and copolymers grafted onto elastomeric backbones are available. The unique property of these materials is outstanding resistance to passage of gases and water vapor, making them useful in packaging applications.

NYLON

A generic name for a family of long-chain polyamide engineering thermoplastics which have recurring amide groups [-CO-NH-] as an integral part of the main polymer chain. Nylons are synthesized from intermediates such as dicarboxylic acids, diamines, amino acids and lactams, and are identified by numbers denoting the number of carbon atoms in the polymer chain derived from specific constituents, those from the diamine being given first. The second number, if used, denotes the number of carbon atoms derived from a diacid. Commercial nylons are as follows: *nylon 4* (polypyrrolidone)—a polymer of 2-pyrrolidone [$CH_2CH_2CH_2C(O)NH$]; *nylon 6* (polycaprolactam)—made by the polycondensation of caprolactam [$CH_2(CH_2)_4NHCO$]; *nylon 6/6*—made by condensing hexamethylenediamine [$H_2N(CH_2)_6NH_2$] with adipic acid [$COOH(CH_2)_4COOH$]; *nylon 6/10*—made by condensing hexamethylenediamine with sebacic acid [$COOH(CH_2)_8COOH$]; *nylon 6/12*—made from hexamethylenediamine and a 12-carbon dibasic acid; *nylon 11*—produced by polycondensation of the monomer 11-amino-undecanoic acid [$NH_2CH_2(CH_2)_9COOH$]; *nylon 12*—made by the polymerization of laurolactam [$CH_2(CH_2)_{10}CO$] or cyclododecalactam, with 11 methylene units between the linking -NH-CO- groups in the polymer chain. Typical applications for nylons are found in automotive parts, electrical/electronic uses, and packaging.

PETROLEUM RESINS

Thermoplastic resins obtained from a variable mixture of unsaturated monomers recovered as a by-product from cracked and distilled petroleum streams. They also contain indene [$C_6H_4CH_2CHCH$], which is copolymerized with a variety of other monomers including styrene [$C_6H_5CHCH_2$], vinyl toluene [$CH_2CHC_6H_4CH_3$], and methyl indene [$C_6H_3CH_3CH_2CHCH$]. Typical applications are found in adhesives, printing inks, rubber compounding, and surface coatings.

PHENOLIC

These thermosetting resins are credited with being the first commercialized wholly synthetic polymer or plastic. The basic raw materials are formaldehyde [HCHO] and phenol [C_6H_5OH], although almost any reactive phenol or aldehyde can be used. The phenols used commercially are phenol, cresols [$CH_3C_6H_4OH$], xylenols [$(CH_3)_2C_6H_3OH$], p-t-butylphenol [$C_4H_9C_6H_4OH$], p-phenylphenol [$C_6H_5C_6H_4OH$], bisphenols [$(C_6H_4OH)_2$], and resorcinol [$C_6H_4(OH)_2$]. The aldehydes used are formaldehyde and furfural [C_4H_3OCHO]. In the uncured and semi-cured condition, phenolic resins are used as adhesives, casting resins, potting compounds, and laminating resins. As molding powders, phenolic resins can be found in electrical uses.

POLYAMIDE-IMIDE

Engineering thermoplastic resins produced by the condensation reaction of trimellitic anhydride [$OCC_6H_2C_2O_3$] and various aromatic diamines. Typical applications are found in aerospace, automotive and heavy equipment industries.

POLYARYLATES

Engineering thermoplastic resins produced by interfacial polymerization of an aqueous solution of the disodium salt of bisphenol A [$(CH_3)_2C(C_6H_4OH)_2$] with phthalic acid chlorides [$C_6H_4(CO)_2Cl_2$] in methylene chloride (CH_2Cl_2]. The major use of polyarylates is in outdoor lighting.

POLYBUTYLENE

Thermoplastic resins produced via stereospecific Ziegler-Natta polymerization of butene-1 monomer [$CH_2CHCH_2CH_3$]. Typical applications are found in pipe and packaging film.

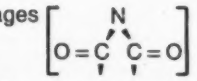
POLYCARBONATE

Engineering thermoplastic resins produced by (1) phosgenation of dihydric phenols, usually bisphenol A [$(CH_3)_2C(C_6H_4OH)_2$], (2) ester exchange between diaryl carbonates and dihydric phenols, usually between diphenyl carbonate [$(C_6H_5O)_2CO$] and bisphenol A and (3) interfacial polycondensation of bisphenol A and phosgene [$COCl_2$]. Typical applications are found in glazing, appliances, and electrical uses.

POLYETHYLENE

A family of thermoplastic resins obtained by polymerizing the gas ethylene [C_2H_4]. Low molecular weight polymers of ethylene are fluids used as lubricants; medium weight polymers are waxes miscible with paraffin; and the high molecular weight polymers (i.e. over 6000) are the materials used in the plastics industry. Polymers with densities ranging from about .910 to .925 are called *low density;* those of densities from .926 to .940 are called *medium density;* and those from .941 to .965 and over are called *high density.* The low density types are polymerized at very high pressures and temperatures, and the high density types at relatively low temperatures and pressures. A relatively new type called linear low density polyethylene is manufactured through a variety of processes: gas phase, solution, slurry, or high pressure conversion. A high efficiency catalyst system aids in the polymerization of ethylene at lower temperatures and pressures than required in conventional low density polyethylene. Copolymers of ethylene with vinyl acetate ethyl acrylate, and acrylic acid are commercially important. Major polyethylene applications can be found in packaging, housewares, toys, and communications equipment.

POLYIMIDES

A family of thermoset and thermoplastic resins characterized by repeating imide linkages 

There are four types of aromatic polyimides: (1) condensation products made by the reaction of pyromellitic dianhydride (PMDA) [$C_6H_2(C_2O_3)_2$] and aromatic diamines such as 4,4'-diaminodiphenyl ether [$(C_6H_4NH_2)_2O$]; (2) condensation products of 3,4,3',4'-benzophenone tetracarboxylic dianhydride (BTDA) [$(C_6H_5)_2CO(C_2O_3)_2$] and aromatic amines; (3) the reaction of BTDA and a diisocyanate such as 4,4'-methylene-bis(phenylisocyanate) [$OCNC_6H_4CH_2C_6H_4NCO$]; and, (4) a polyimide based on diaminophenylindane and a dicarboxylic anhydride such as carbonyldiphthalic anhydride [$OC_6H_4(CO)_2COC_6H_4(CO)_2O$]. Thermoset polyimides are produced in condensation polymers that possess reactive terminal groups capable of subsequent cross-linking through an addition reaction. Typical applications for thermoplastic and thermosetting polyimides are in transportation and electronics.

POLYPHENYLENE OXIDE, MODIFIED

Engineering thermoplastic resins produced by the oxidative coupling of 2, 6-dimethylphenol [$(CH_3)_2C_6H_3OH$] (xylenol), then blended with impact polystyrene. Typical applications are found in electrical/electronic uses, business machine parts, appliances, and automotive parts.

POLYPHENYLENE SULFIDE

Engineering thermoplastic resins produced by the reaction of p-dichlorobenzene [$C_6H_4Cl_2$] with sodium sulfide [Na_2S]. The major use for polyphenylene sulfide is in electrical/electronic parts and automotive parts.

POLYPROPYLENE

Thermoplastic resins made by polymerizing propylene [CH_3CHCH_2] and in the case of copolymers with monomers, with suitable catalysts, generally aluminum alkyl and titanium tetrachloride mixed with solvents. The monomer unit in polypropylene is asymmetric and can assume two regular geometric arrangements: isotactic, with all methyl groups aligned on the same side of the chain, or syndiotactic, with the methyl groups alternating. All other forms, where this positioning is random, are called atactic. Commercial polypropylene contains 90-97% crystalline or isotactic PP with the remainder being atactic. Most processes remove excess atactic PP. This by-product is used in adhesives, caulks, and cable-filling compounds. Major applications of commercial PP are found in packaging, automotive, appliance and carpeting markets.

POLYSTYRENE

High molecular weight thermoplastic resins produced generally by the free-radical polymerization of styrene monomer [$C_6H_5CHCH_2$] which can be initiated by heating alone but more effectively by heating in the presence of a free-radical initiator (such as benzoyl peroxide [$(C_6H_5CO)_2O_2$]). Typical processing techniques are modified mass polymerization or solution polymerization, suspension polymerization, and expandable beads. Major markets for polystyrene are in consumer and institutional products, electrical/electronic uses, and building/construction.

POLYURETHANES

A large family of polymers based on the reaction product of an organic isocyanate with compounds containing a hydroxyl group. The commonly used isocyanates are toluene diisocyanate (TDI) [$CH_3C_6H_3(NCO)_2$], methylene diphenyl isocyanate (MDI) [$OCNC_6H_4CH_2C_6H_4NCO$], and polymeric isocyanates (PMDI), obtained by the phosgenation of polyamines derived from the condensation of aniline [$C_6H_5NH_2$] with formaldehyde [HCHO]. Polyols (with hydroxyl groups) are macroglycols which are either polyester or polyether based. Polyurethane elastomers and resins take the form of liquid casting systems, thermoplastic elastomers and resins, microcellular products, and millible gums. Typical applications are found in the automotive industry. Polyurethane foams are widely used in transportation, furniture, and construction markets.

POLYVINYL ACETATE (PVAc) & OTHER VINYLS

Polyvinyl acetate is a thermoplastic resin produced by the polymerization of vinyl acetate monomer [$CH_3COCCHCH_2$] in water producing an emulsion with a solids content of 50-55%. Most polyvinyl acetate emulsions contain co-monomers such as n-butyl acrylate, 2-ethyl hexyl acrylate, ethylene, dibutyl maleate and dibutyl fumarate. Polymerization of vinyl acetate with ethylene also can be used to produce solid vinyl acetate/ethylene copolymers with more than 50% vinyl acetate content. Polyvinyl alcohol (PVOH) is produced by methanolysis or hydrolysis of polyvinyl acetates. The reaction can be controlled to produce any degree of replacement of acetate groups. Co-polymers of replaced acetate groupings and other monomers such as ethylene and acrylate esters are commercially important. *Polyvinyl butyral* (PVB)—made by reacting PVOH with butyraldehyde [$CH_3(CH_2)_2CHO$]. *Polyvinyl formal*—made by condensing formaldehyde [HCHO] in the presence of PVOH or by the simultaneous hydrolysis and acetylization of PVAc. *Polyvinylidene chloride*—made by the polymerization of 1,1-dichloroethylene [CH_2CCl_2]. Typical applications for the above resins are found in adhesives, paints, coatings and finishes, and packaging.

POLYVINYL CHLORIDE

Thermoplastic resins produced by the polymerization of the gas vinyl chloride [CH_2CHCl]. Under pressure, vinyl chloride becomes liquified and is polymerized by one of four basic processes: suspension, emulsion, bulk, and solution polymerization. The pure polymer is hard, brittle and difficult to process, but it becomes flexible when plasticizers are added. A special class of PVC resin of fine particle size, often called dispersion grade resin, can be dispersed in liquid plasticizers to form plastisols. The addition of a volatile diluent or a solvent to the plastisol produces an organosol. Copolymers with vinyl acetate, vinylidene chloride, and maleate and fumarate esters find commercial application. Major markets for PVC are in building/construction, packaging, consumer and institutional products, and electrical/electronic uses.

STYRENE ACRYLONITRILE

Thermoplastic copolymers of styrene [$C_6H_5CHCH_2$] and acrylonitrile [CH_2CHCN]. SAN resins are random, amorphous copolymers produced by emulsion, suspension, or continuous mass polymerization. Typical uses include automobile instrument lenses and housewares.

STYRENE BUTADIENE LATEXES & OTHER STYRENE COPOLYMERS

Styrene butadiene latexes usually have a resin content of about 50%. The styrene/butadiene ratio varies from 54:46 to 80:20. Most are carboxylated by the use of such acids as maleic [HOOCCHCHCOOH], fumaric [HOOCCHCHCOOH], acrylic [$CH_2CHCOOH$], or methacrylic [$CH_2C(CH_3)COOH$]. Two types of *styrene-maleic anhydride* (SMA) [$(COCH)_2O$] are available: SMA copolymers, with and without rubber impact modifier (e.g. DYLARK®) and SMA terpolymer alloys (e.g. CADON®). *K-Resin®* is a solid styrene-butadiene copolymer resin. Acrylic monomers are also used in conjunction with styrene (or styrene plus other monomers) to produce specialty resins. For example, there are transparent terpolymers of methyl methacrylate, butadiene, and styrene (MBS), and others of acrylonitrile, an acrylic monomer, and styrene (AAS). Ion-exchange resins or divinylbenzene-modified polystyrene are another variation. SB latexes are used in carpet backing and paper coatings. The other styrenics are used in paints, coatings, and floor polishes, plus many other uses.

SULFONE POLYMERS

A family of engineering thermoplastic resins characterized by the sulfone [SO_2] group. *Polysulfone* is made by the reaction of the disodium salt of bisphenol A [$(CH_3)_2C(C_6H_4OH)_2$] with 4,4'-dichlorodiphenyl sulfone(4,4'-DCDPS [$(C_6H_4Cl)_2SO_2$]. *Polyethersulfone* is made by the reaction of 4,4'-DCDPS with potassium hydroxide [KOH]. *Polyphenylsulfone* is similar to the other sulfone polymers. Typical applications for sulfone polymers are found in electrical/electronic uses and automotive parts.

THERMOPLASTIC POLYESTER (SATURATED)

A family of polyesters in which the polyester backbones are saturated and hence unreactive. The most common commercial types are: *PET* (polyethylene terephthalate) produced by polycondensation of ethylene glycol [CH_2OHCH_2OH] with either dimethyl terephthalate (DMT) [$C_6H_4(COOCH_3)_2$] or terephthalic acid (TPA) [$C_6H_4(COOH)_2$]; and *PBT* (polybutylene terephthalate) produced by the reaction of DMT with 1,4 butanediol [$NO(CH_2)_4OH$]. Typical applications are found in packaging, automotive, electrical, and consumer markets.

UREA-FORMALDEHYDE

Formed by the condensation reaction of formaldehyde [HCHO] and urea [$CO(NH_2)_2$]. These thermoset resins are clear water-white syrups or white powdered materials which can be dispersed in water to form colorless syrups. They cure at elevated temperatures with appropriate catalysts. Molding powders are made by adding fillers to the uncured syrups, forming a consistency suitable for compression and transfer molding. The liquid and dried resins find extensive use in laminates and chemically-resistant coatings. The molding compounds are formed into rigid electrical and decorative products.

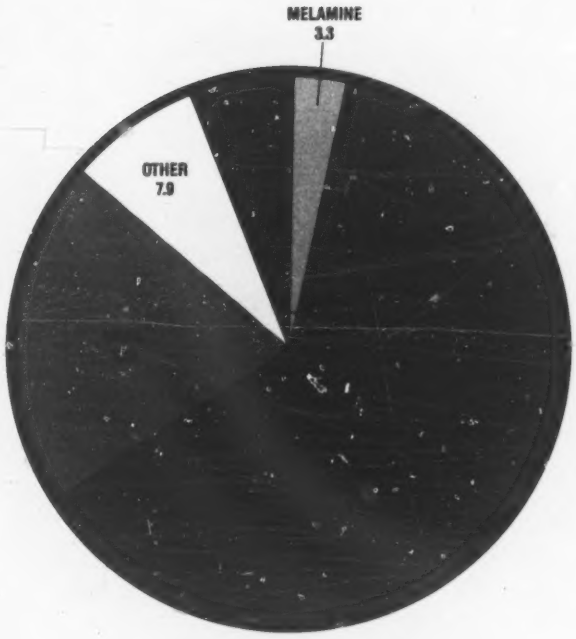
UNSATURATED POLYESTER

Thermosetting resins made by the condensation reaction between difunctional acids and glycols. The resulting polymer is then dissolved in styrene [$C_6H_5CHCH_2$] or other vinyl unsaturated monomer. The structures of the acids and glycols used and their proportions, especially the ratio of the unsaturated versus the saturated acid, and the type and amount of monomer used, are all tailored for each resin to balance economy, processing characteristics, and performance properties. One common formulation is the reaction of maleic anhydride [$(COCH)_2O$], phthalic anhydride [$C_6H_4(CO)_2O$], and propylene glycol [$CH_3CHOHCH_2OH$]. Both dicyclopentadiene [$(C_5H_6)_2$] and isophthalic acid [$C_6H_4(COOH)_2$] can be substituted for phthalic anhydride. Vinyl ester resins are linear reaction products of bisphenol A [$(CH_3)_2C(C_6H_4OH)_2$] and epichlorohydrin [CH_2OCHCH_2Cl] that are terminated with an unsaturated acid such as methacrylic acid [$CH_2C(CH_3)COOH$]. Typical applications are found in transportation, appliances, electrical, and construction markets.

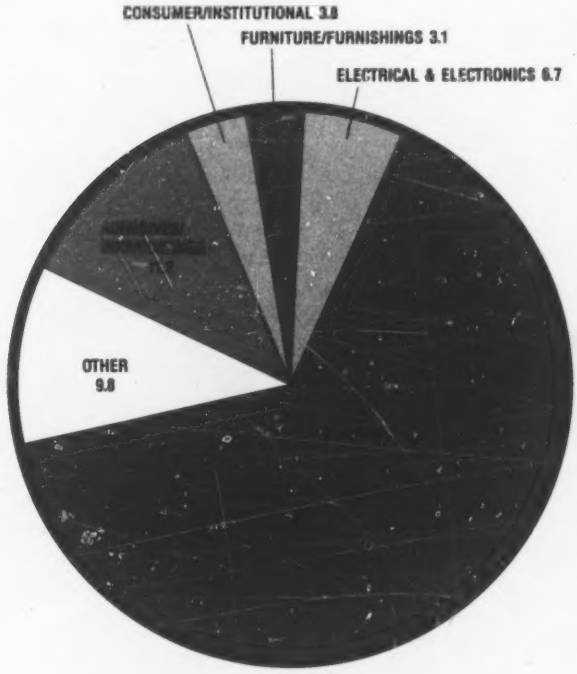
Sources: *Chemical Economics Handbook*, SRI International
Modern Plastics Encyclopedia
Whittington's Dictionary
The Condensed Chemical Dictionary

THERMOSETTING RESINS

Plastics which in their final state as finished articles are substantially infusible and insoluble. They are often liquids at some state of their manufacture or processing, which are cured by heat, catalysts or other chemical means. After being fully cured, therm osets cannot be resoftened by heat.



1984 PERCENT OF THERMOSET RESIN
SALES & CAPTIVE USE
BY MATERIAL



1984 PERCENT OF THERMOSET RESIN
SALES & CAPTIVE USE
BY MAJOR MARKET

EPOXY

MANUFACTURERS*

Celanese Specialties Co.
Ciba-Geigy Corp.
Dow Chemical U.S.A.
Reichhold Chemicals, Inc.
Shell Chemical Co.
Union Carbide Corp.

*Those manufacturers who participated in the SPI Monthly Statistical Report in 1984.

PRODUCTION AND SALES & CAPTIVE USE

(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1975	198	187
1976	244	250
1977	261	278
1978	299	316
1979	361	332
1980	315	319
1981	336	332
1982	286	301
1983	334	331
1984	406	379
COMPOUND GROWTH RATE		
1974–1984	5.0%	4.7%

PERCENT OF TOTAL U.S. SALES & CAPTIVE USE	
1975	0.88
1976	0.93
1977	0.89
1978	0.90
1979	0.86
1980	0.91
1981	0.90
1982	0.86
1983	0.82
1984	0.88

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

EPOXY

DOMESTIC CONSUMPTION BY END-USE

(in millions of pounds)

END-USE	1980	1981	1982	1983	1984
Bonding & adhesives	18	18	15	15	20
Flooring, paving and aggregates	19	20	18	19	18
Protective coatings	137	137	122	131	153
Fiber reinforced laminates & composites	63	66	58	74	87
Tooling, casting, and molding resins	26	29	24	28	31
All other cases	20	21	25	29	29
Total	283	291	262	296	338

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET

(in millions of pounds)

MAJOR MARKET	1980	1981	1982	1983	1984
Transportation	*	*	*	*	*
Packaging	*	*	*	*	*
Building/Construction	48	49	44	36	36
Electrical/Electronic	55	58	60	73	82
Furniture/Furnishings	—	—	—	*	*
Consumer & Institutional	—	*	—	*	*
Industrial/Machinery	—	*	*	*	*
Adhesives, Inks & Coatings	150	151	134	118	122
All Other	30	33	24	69	98
Exports	36	41	39	35	41
Total	319	332	301	331	379

* Included in All Other

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

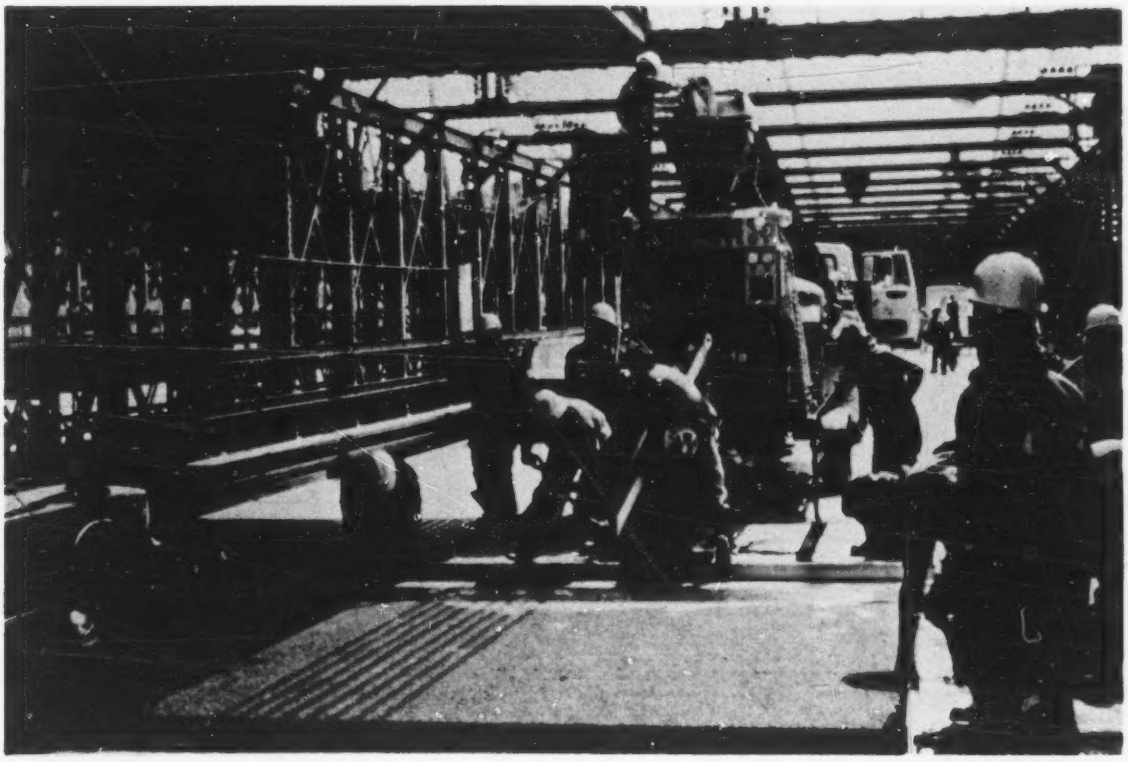
EPOXY

TYPICAL APPLICATIONS

Coatings
Electrical laminates
Floor/paving aggregates

Reinforced composites
Electrical/Electronic casting

Adhesives
and molding



Epoxy/aggregate is applied to surface of the Brooklyn Bridge. Binder system contains Araldite epoxy resins, manufactured by CIBA-GEIGY.

PHENOLIC

MANUFACTURERS*

Acme Resins Co.
American Hoechst Corp.
Ametek, Haveg Div.
Ashland Chemical Co.
Bendix Corp.
Borden Chemical Co., Inc.
Chembond Corp.
Formica Corp.
Georgia-Pacific Corp.
Inmont Corp.
Ironsides Resins, Inc.
Koppers Co.
Owens-Corning Fiberglas Corp.
Perkins Industries, Inc.
Pioneer Plastics Corp.
Plaslok Corp.
Plastics Engineering Co.
Polymer Applications, Inc.
Polyrez Co., Inc.
Raymark Industries, Inc.
Reichhold Chemicals, Inc.
Rogers Corp.
Union Carbide Corp.
Uniroyal Chemical Div., Uniroyal, Inc.
Valite Div., Valentine Sugars, Inc.
Van Leer Containers, Inc.

*Those manufacturers who participated in the SPI Monthly Statistical Report in 1984.

PRODUCTION AND SALES & CAPTIVE USE**

(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1975	1,051	1,034
1976	1,340	1,305
1977	1,458	1,400
1978	1,827	1,788
1979	1,781	1,732
1980	1,499	1,517
1981	2,333	2,375
1982	2,006	2,060
1983	2,484	2,529
1984	2,502	2,510
COMPOUND GROWTH RATE		
1974–1984	n.c.	n.c.

PERCENT OF TOTAL U.S. SALES & CAPTIVE USE	
1975	4.89
1976	4.84
1977	4.50
1978	5.10
1979	4.47
1980	4.31
1981	6.43
1982	5.87
1983	6.24
1984	5.79

*Gross weight basis of reporting begun in 1981.
n.c. = not comparable.
Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

PHENOLIC
DOMESTIC CONSUMPTION BY END-USE**

(in millions of pounds)

End-use	1980	1981	1982	1983	1984
Molding Compounds	246	249	192	232	238
Bonding & adhesive resins for:					
Laminating	97	134	127	166	149
Coated & bonded abrasives	34	37	25	28	23
Friction materials	35	29	25	32	35
Insulation materials	271	362	347	355	307
Foundry & shell molding	80	82	56	70	81
Plywood	445	1,110	1,012	1,309	1,319
Fibrous & granulated wood	88	201	146	179	184
Resins sold to Rubber Industry	28	24	23	27	30
All other	74	59	51	59	62
Protective coatings	24	26	18	19	22
All other uses	72	42	23	30	38
Total	1,494	2,355	2,045	2,506	2,488

**Gross weight basis of reporting begun in 1981.
Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET**

(in millions of pounds)

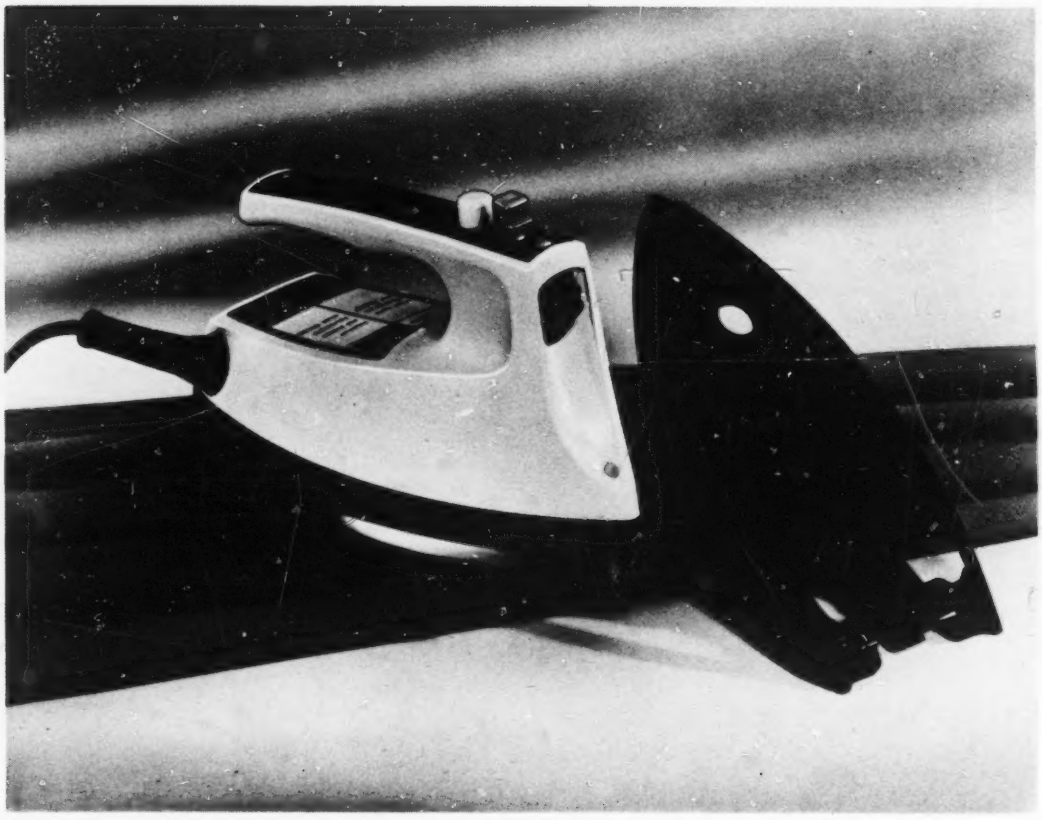
MAJOR MARKET	1980	1981	1982	1983	1984
Transportation	135	167	129	156	150
Packaging	10	*	*	*	*
Building/Construction	858	1,672	1,543	1,936	1,921
Electrical/Electronic	181	209	170	176	162
Furniture/Furnishings	11	25	26	*	*
Consumer & Institutional	33	*	*	44	*
Industrial/Machinery	21	27	*	11	9
Adhesives, Inks & Coatings	186	166	73	70	80
All Other	59	89	104	113	166
Exports	23	20	15	23	22
Total	1,517	2,375	2,060	2,529	2,510

**Gross weight basis of reporting begun in 1981
*Included in all other
Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

PHENOLIC

TYPICAL APPLICATIONS

Wiring devices
Connectors
Transmission parts
Pulleys
Electrical switch gear
Closures
Handles
Telephone relay systems
Rubber tackifiers
Laminating plywood
Knobs
Power brake components



This iron skirt is made from phenolic resin supplied by Rogers Corp.

UNSATURATED POLYESTER

MANUFACTURERS*

Advance Coatings Corp.
Alpha Chemical Corp.
Ashland Chemical Co.
AZS Corp.
Cargill, Inc.
Cook Paint & Varnish Co.
Dow Chemical U.S.A.
Freeman Chemical Corp.
Glidden Coatings & Resin Div. SCM Corp.
ICI Americas, Inc.
Inmont Corp.
Interplastics Corp.
Koppers Co.
Owens-Corning Fiberglas Corp.
Pioneer Plastics Corp.
Reichhold Chemicals, Inc.
Sherwin Williams Co., The
Sohio Chemical Co.
USS Chemicals Co.

*Those manufacturers who participated in the SPI Monthly Statistical Report in 1984.

PRODUCTION AND SALES & CAPTIVE USE

(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1975	834	771
1976	1,042	959
1977	1,061	1,045
1978	1,209	1,199
1979	1,147	1,152
1980	947	949
1981	997	977
1982	865	851
1983	1,084	1,072
1984	1,232	1,231
COMPOUND GROWTH RATE		
1974–1984	3.1%	3.1%

	PERCENT OF TOTAL U.S. SALES & CAPTIVE USE
1975	3.64
1976	3.55
1977	3.36
1978	3.42
1979	2.98
1980	2.70
1981	2.64
1982	2.42
1983	2.65
1984	2.84

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

UNSATURATED POLYESTER
MAJOR DOMESTIC MARKETS
(in millions of pounds)

	1980	1981	1982	1983	1984
DOMESTIC REINFORCED PLASTICS, TOTAL	**739**	**764**	**629**	**818**	**939**
Marine and marine accessories	171	169	156	215	249
Transportation	80	84	65	88	99
Auto, trucks, buses, etc.	63	65	53	75	83
Other transportation	17	19	12	13	16
Construction	287	301	279	340	389
General construction	114	122	114	135	172
Bathroom components & fixtures, general purpose tanks & pipes	79	78	75	93	100
Corrosion resistant tanks, pipes, etc.	94	101	90	112	117
Electrical generation, transmission and distribution	23	22	17	26	37
Consumer goods	66	66	51	81	85
Major appliances and parts	7	10	19	21	19
Recreational goods, toys, etc.	19	24	22	40	39
Other consumer goods	40	32	10	20	27
Gel coats	26	32	31	36	43
Other reinforced	86	90	30	32	37
DOMESTIC NON-REINFORCED PLASTICS, TOTAL	**214**	**202**	**214**	**244**	**283**
Castings	144	123	103	118	161
Furniture	6	7	4	4	5
Cultured marble & onyx	63	61	62	81	107
Other	75	55	37	33	49
Autobody putty	41	45	60	61	56
Surface and protective coatings	5	5	4	5	5
Bonding and adhesives	5	3	2	2	3
Minebolt anchor resins	n.a.	n.a.	n.a.	n.a.	21
Other non-reinforced	19	26	45	58	37

n.a.=not available
Source: Quarterly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in million of pounds)

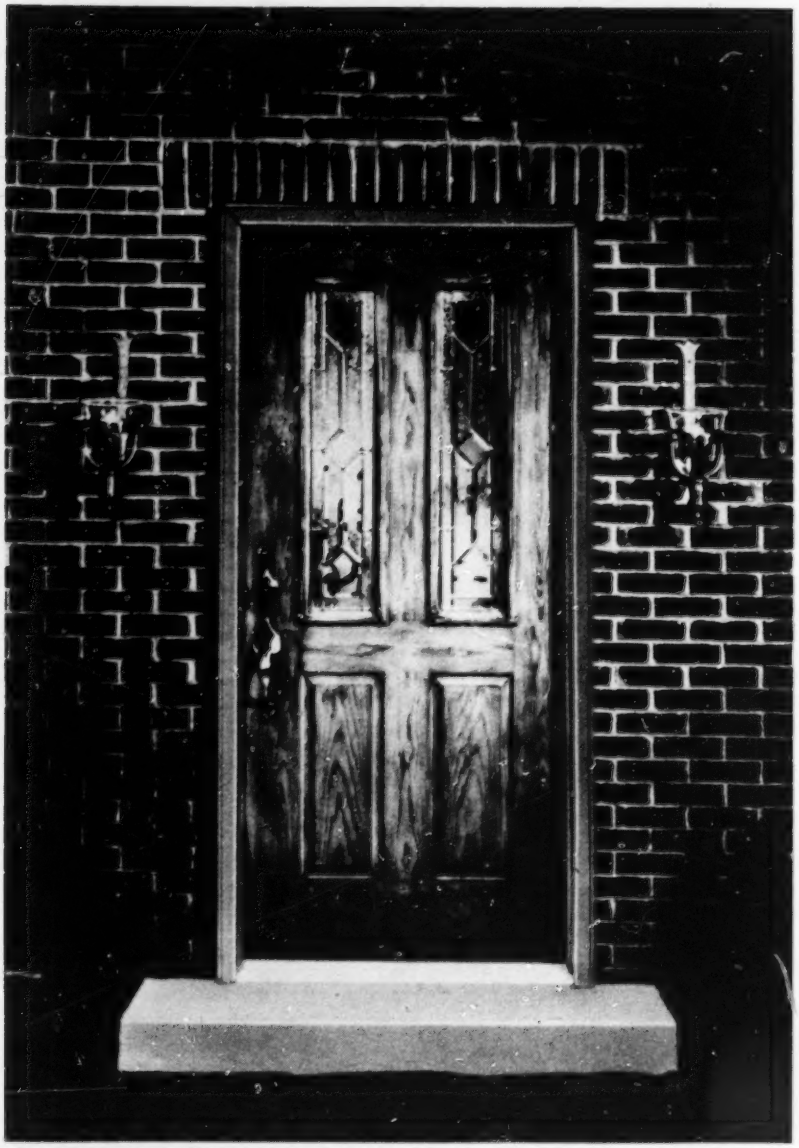
MAJOR MARKET	1980	1981	1982	1983	1984
Transportation	261	259	244	316	388
Packaging	*	*	—	—	—
Building/Construction	384	401	353	496	502
Electrical/Electronic	25	33	26	52	66
Furniture/Furnishings	26	24	3	2	11
Consumer & Institutional	100	94	95	81	72
Industrial/Machinery	*	*	—	*	*
Adhesives, Inks & Coatings	10	9	7	*	*
All Other	132	146	115	115	184
Exports	11	11	8	10	8
Total	**949**	**977**	**851**	**1,072**	**1,231**

*Included in all other.
Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

UNSATURATED POLYESTER

TYPICAL APPLICATIONS

Panels	Sanitary fixtures	Pleasure boats
Tanks	Synthetic marble	Bowling balls
Auto components	Recreational vehicles	Showerstalls



The Therma-True® line of Fiber-Classic® doors combines the insulation and security values of insulated steel doors with the wood grain and beauty of wood doors. The Fiber-Classic skins are compression molded of fiber glass reinforced E933 low profile polyester resins supplied by Owens-Corning Fiberglas Corporation.

UREA

MANUFACTURERS*

American Cyanamid Co.
Borden Chemical Co., The
Celanese Specialties Co.
Chembond Corp.
Dan River, Inc.
Georgia-Pacific Corp.
Grifftex Chemicals, Inc.
Guardsman Chemicals, Inc.
Maplechem, Inc.
Monsanto Co.
Perkins Industries
Perstorp U.S., Inc.
Pioneer Plastics Corp.
Plastics Manufacturing Co.
Reichhold Chemicals, Inc.
Valchem Div. United Merchants, Inc.

*Those manufacturers who participated in the SPI Monthly Statistical Report in 1984.

PRODUCTION AND SALES & CAPTIVE USE

(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1975	690	685
1976	821	809
1977	963	951
1978	1,122	1,103
1979	1,367	1,355
1980	1,165	1,147
1981	1,165	1,139
1982	998	976
1983	1,172	1,167
1984	1,199	1,189
COMPOUND GROWTH RATE		
1974–1984	3.7%	3.8%

PERCENT OF TOTAL U.S. SALES & CAPTIVE USE

1975	3.24
1976	3.00
1977	3.06
1978	3.15
1979	3.50
1980	3.26
1981	3.08
1982	2.78
1983	2.88
1984	2.75

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

MELAMINE

MANUFACTURERS*

American Cyanamid Co.
American Hoechst Corp.
Borden Chemical Co., The
Celanese Specialties Co.
Chembond Corp.
Formica Corp.
Grifftex Chemicals, Inc.
Guardsman Chemicals, Inc.
Maplechem, Inc.
Monsanto Co.
Owens-Corning Fiberglas Corp.
Perstorp U.S., Inc.
Pioneer Plastics Corp.
Plastics Manufaturing Co.
Reichhold Chemicals, Inc.

*Those manufacturers who participated in the SPI Monthly Statistical Report in 1984.

PRODUCTION AND SALES & CAPTIVE USE

(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1975	115	117
1976	186	182
1977	200	203
1978	202	196
1979	200	192
1980	167	166
1981	179	175
1982	158	155
1983	180	181
1984	210	197
COMPOUND GROWTH RATE		
1974–1984	2.5%	2.4%

PERCENT OF TOTAL U.S. SALES & CAPTIVE USE

1975	0.55
1976	0.67
1977	0.65
1978	0.56
1979	0.50
1980	0.47
1981	0.47
1982	0.44
1983	0.44
1984	0.46

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

UREA AND MELAMINE

DOMESTIC CONSUMPTION BY END-USE

(in millions of pounds)

END-USE	1980	1981	1982	1983	1984
Textile treating & coating resins	n.a.	n.a.	n.a.	n.a.	23
Paper treating & coating resins	70	73	68	74	98
Bonding & adhesive resins for:					
Laminating	27	32	27	40	44
Plywood	74	74	64	63	59
Fibrous & granulated wood	896	884	759	918	944
Protective coatings	66	69	64	76	84
All other uses	162	158	132	155	134
Total	1,295	1,290	1,114	1,326	1,386

n.a.=not available

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION OF UREA/MELAMINE BY MAJOR MARKET

(in millions of pounds)

MAJOR MARKET	1980	1981	1982	1983	1984
Transportation	*	*	*	*	*
Packaging	*	*	44	45	32
Building/Construction	833	820	712	844	896
Electrical/Electronic	*	*	*	*	*
Furniture/Furnishings	168	181	148	*	*
Consumer & Institutional	51	48	*	*	*
Industrial/Machinery	*	*	—	—	—
Adhesives, Inks & Coatings	99	90	65	*	*
All Other	144	151	145	438	458
Exports	18	24	17	21	*
Total	1,313	1,314	1,131	1,348	1,386

*Included in all other

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

UREA AND MELAMINE
TYPICAL APPLICATIONS

UREA		MELAMINE	
Wiring devices	Buttons	Adhesives and bonding	Dinnerware
Toilet seats	Knobs	Buttons	Knobs
Handles	Adhesives and bonding	Handles	Ashtrays

MISCELLANEOUS THERMOSETS

(in millions of pounds)

PRODUCTION

Resin	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Alkyds	734	726	674	705	753	754	755	703	717	523	719
Furfuryl-type	4	4	8	8	n.a.	17	31	25	24	20	18
Silicones	18	18	12	15	18	16	20	12	17	13	16
Dicyandiamide	2	2	2	2	2	2	2	2	2	1	1
Other[1]	34	33	18	26	91	60	70	169	107	125	135

SALES

Resin	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Alkyds	397	403	380	471	434	415	408	392	420	284	427
Furfuryl	3	4	n.a.	n.a.	n.a.	16	30	25	23	18	18
Silicones	13	13	8	13	11	11	11	8	8	8	9
Dicyandiamide	2	2	1	2	2	2	2	2	2	1	1
Other[1]	13	19	21	24	70	49	61	121	78	104	114

n.a. = not available.

[1] Includes acetone-formaldehyde, glyoxal-formaldehyde, polybutadiene, thiourea, and other thermosets.

Source: *Synthetic Organic Chemicals*, U.S. International Trade Commission.

DISTRIBUTION OF POLYURETHANE FOAM SALES AND USE BY MAJOR MARKET

(in millions of pounds)

	Quantity					% of Total				
	1980	1981	1982	1983	1984	1980	1981	1982	1983	1984
Transportation	288	268	248	301	330	16.8%	15.4%	14.8%	15.8%	16.1%
Flexible	242	227	216	269	300	14.1	13.0	12.9	14.1	14.6
Rigid	46	41	32	32	30	2.7	2.4	1.9	1.7	1.5
Packaging	57	77	77	85	90	3.3	4.4	4.6	4.3	4.4
Flexible	23	35	34	38	40	1.3	2.0	2.0	2.0	2.0
Rigid	34	42	43	47	50	2.0	2.4	2.6	2.3	2.4
Furniture/Furnishings	872	898	859	872	895	50.9	51.5	51.3	45.7	43.7
Flexible	850	832	834	856	875	49.7	50.6	49.8	44.8	42.7
Rigid	22	16	21	16	20	1.2	0.9	1.5	0.9	1.0
Building/Construction	315	328	328	379	400	18.4	18.8	19.6	19.9	19.5
Electrical/Electronic	69	76	80	87	100	4.1	4.4	4.8	4.6	4.8
All Other	111	97	82	185	235	6.5	5.5	4.9	9.7	11.5
Total	1,712	1,744	1,674	1,909	2,050	100.0%	100.0%	100.0%	100.0%	100.0%

POLYURETHANE FOAM—DOMESTIC SALES & CAPTIVE USE

(in millions of pounds)

	1980	1981	1982	1983	1984[a]	Compound Growth Rate 1979–1984
Flexible and Semi-Flexible Foam						
Bedding (excluding sofa beds)	139	143	125	149	165	+ 1.7%
Furniture	432	437	431	503	500	+ 1.7
Packaging	23	35	34	38	40	+ 5.3
Rug and Underlay	161	165	141	165	170	+ 3.5
Textile Laminates	38	36	34	39	40	– 1.0
Transportation	242	227	216	269	300	– 3.1
Miscellaneous	58	40	43	35	45	+ 0.5
Scrap	80	101	103	113	140	– 1.4
Total Flexible and Semi-Flexible Foam	1,173	1,184	1,127	1,311	1,400	+ 0.4%
Rigid Foam						
Appliances	69	76	80	87	100	+ 3.5%
Building Construction	315	328	328	379	400	+ 4.4
Furniture	22	16	21	16	20	– 4.4
Marine Flotation	15	15	12	10	10	– 10.1
Packaging	34	42	43	47	50	+ 10.0
Transportation	46	41	32	32	30	– 9.4
Miscellaneous	38	42	31	27	40	+ 8.2
Total Rigid Foam	539	560	547	598	650	+ 3.2%
Grand Total Foam	1,712	1,744	1,674	1,909	2,050	+ 1.2%

Source: Polyurethane Foam End-use Survey,
SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.
[a] Estimated

ISOCYANATES

(in millions of pounds)

	PRODUCTION			SALES & CAPTIVE USE
Year	Total	TDI*	Other Isocyanates	Total
1980	1,126	536	590	1,079
1981	1,147	537	610	1,138
1982	1,042	547	495	1,052
1983	1,156	624	532	1,135
1984	1,331	680	651	1,312

*Toluene Diisocyanate (80/20 mixture)

POLYETHER POLYOLS

(in millions of pounds)

Year	Production	Sales & Captive Use
1980	1,225	1,231
1981	1,264	1,266
1982	1,111	1,209
1983	1,296	1,286
1984	1,347	1,305

POLYESTER POLYOLS

(in millions of pounds)

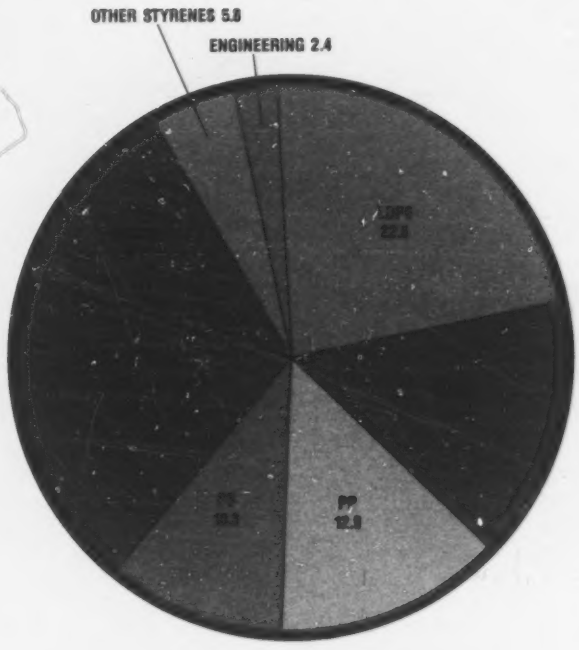
Year	Production	Sales & Captive Use
1980	42	40
1981	47	46
1982	28	28
1983	29	26
1984	26	26

PARTICIPATING COMPANIES—1984	Isocyanates	Polyether Polyols	Polyester Polyols
BASF Wyandotte Corp.	X	X	
Chemetic Systems			
Choate Chemical		X	
Dow Chemical U.S.A.	X	X	
E.I. duPont de Nemours & Co.		X	
ICI Americas			
Mobay Chemical Corp.	X	X	X
Olin Corp.	X	X	
Owens-Corning Fiberglas Corp.		X	
PPG Industries		X	
Quaker Oats Co.		X	
Reichhold Chemicals, Inc.		X	
Rubicon Chemicals, Inc.	X		
Ruco Div. Occidental Chemicals Corp.			
Stepan Chemical Co.		X	
Texaco, Inc.		X	
U.C.T., Inc.			
Union Carbide Corp.		X	X
Uniroyal Chemical Co.			X
The Upjohn Co.	X	X	
Witco Chemical Co.		X	X

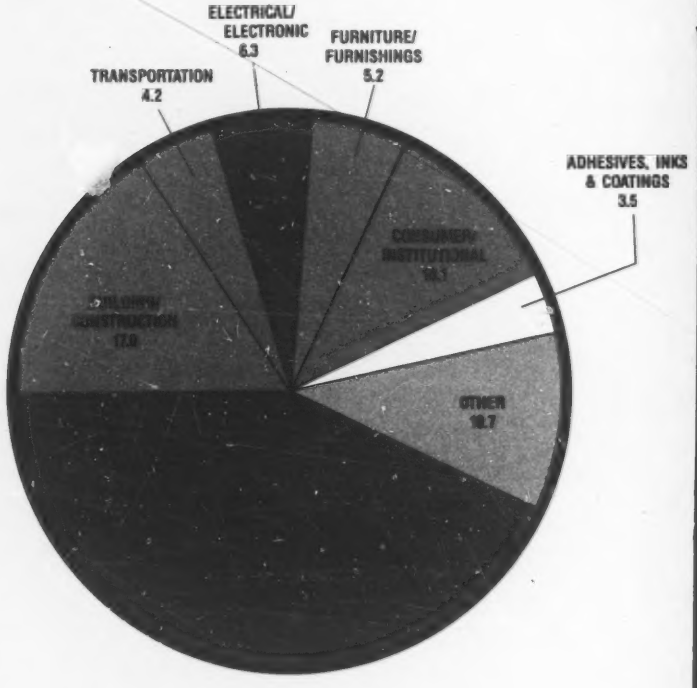
Source: Quarterly Polyols and Isocyanates Reports, SPI Committee on Resin Statistics as compiled by Ernst & Whinney.

THERMOPLASTIC RESINS

Plastics which in their final state as finished articles are capable of being repeatedly softened by increase of temperature and hardened by decrease of temperature and physical change.



1984 PERCENT OF THERMOPLASTIC SALES & CAPTIVE USE BY MATERIAL



1984 PERCENT OF THERMOPLASTIC SALES & CAPTIVE USE BY MAJOR MARKET

ABS AND SAN

MANUFACTURERS*

Borg Warner Chemicals
Dow Chemical U.S.A.
B.F. Goodrich Chemical Co.
W. R. Grace & Co.
Monsanto Company

*Those companies who participated in the SPI Monthly Statistical Report in 1984.

PRODUCTION AND SALES & CAPTIVE USE

(millions of pounds)

	PRODUCTION		SALES & CAPTIVE USE	
YEAR	ABS	SAN	ABS	SAN
1975	642	109	621	75
1976	988	113	925	104
1977	1,069	115	1,057	113
1978	1,134	120	1,118	121
1979	1,191	124	1,183	126
1980	920	111	916	103
1981	916	107	900	105
1982	740	91	737	85
1983	n.a.	93	n.a.	91
1984	1,128	99	1,098	88
COMPOUND GROWTH RATE				
1974–1984	2.8%	–1.0%	3.0%	–3.0%

n.a. = not available.

PERCENT OF TOTAL U.S. SALES & CAPITAL USE

	ABS	SAN
1975	2.94	0.35
1976	3.43	0.39
1977	3.40	0.36
1978	3.19	0.35
1979	3.06	0.33
1980	2.60	0.29
1981	2.44	0.28
1982	2.10	0.24
1983	n.a.	0.23
1984	2.54	0.20

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

MAJOR DOMESTIC MARKETS

(in millions of pounds)

MARKET	1980	1981	1982	1983	1984
ABS					
Consumer & Institutional	n.a.	132	104	n.a.	n.a.
Pipe, Conduit & Fittings	208	180	111	n.a.	n.a.
Electrical & Electronic	193	195	181	n.a.	n.a.
Transportation	154	161	145	n.a.	n.a.
Other	304	180	148	n.a.	n.a.
Total	859	848	689	1,249	n.a.
SAN					
Total	90	91	75	80	78
Grand Total	949	939	764	1,329	n.a.

n.a.=not available.

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION OF ABS & SAN BY MAJOR MARKET

(in millions of pounds

MAJOR MARKET	1980	1981	1982	1983[a]	1984
Transportation	185	177	156	267	267
Packaging	26	29	*	51	13
Building/Construction	234	194	124	197	*
Electrical/Electronic	265	209	203	246	269
Furniture/Furnishings	8	*	*	7	*
Consumer & Institutional	93	165	129	168	*
Industrial/Machinery	13	*	*	47	*
Adhesives, Inks & Coatings	—	—	—	27	*
All Other	125	165	153	175	638
Exports	69	66	57	144	*
Total	1,019	1,005	822	1,329	1,187

*Included in all other [a]Includes Other Styrene Based Polymers

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

ABS AND SAN
TYPICAL APPLICATIONS

ABS		SAN	
Household appliances	Business machines	Automotive trim	Boat hulls
Telephones	Refrigerator liners	Marine instruments	Solar collectors
Bath tubs	Sporting goods	Tractor components	Swimming pool components

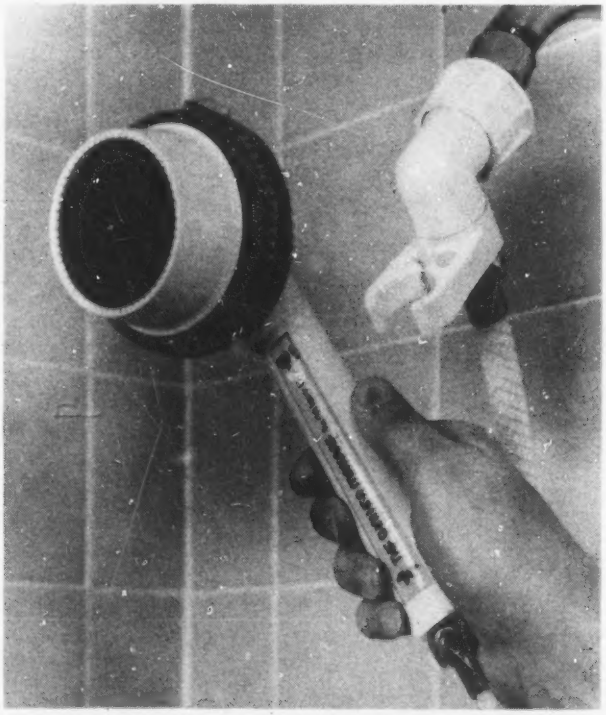
TELEPHONE/COMPUTER TERMINAL, the Displayphone, introduced by Northern Telecom Ltd., uses Cycolac® brand ABS engineering thermoplastics supplied by Borg-Warner Chemicals, Inc. for the enclosure parts.

Photo courtesy of Plastics World Magazine

ENGINEERING THERMOPLASTIC RESINS

TYPICAL APPLICATIONS

Acetal (AC)	Sinks, faucets, electrical switches, gears, aerosol bottles, meat hooks, lawn sprinklers, ballcocks, shaver cartridges, zippers, telephone pushbuttons.
Polycarbonate (PCO)	Helmets, power tool housings, battery cases, safety glass, auto lenses, 5 gal. bottles.
Polyphenylene Sulfide (PPS)	Electrical connectors, coil forms, lamp housings.
Thermoplastic Polyester (TP)	Electrical bobbins, TV tuners, fuse cases, bearings, cams, auto ignition coil caps, speedometer frames, pump impellers and housings.
Polysulfone (PSO)	Electrical connectors, meter housings, coffeemakers, camera bodies, auto switch and relay bases, light-fixture sockets, fuel cell components, battery cases.
Modified Polyphenylene Oxide (PPO)	Auto dashboards, pumps, shower heads, plated auto grilles and trim, appliance housings, wiring splice devices, protective shields.
Polyimide (PI)	Radomes, printed circuit boards, turbine blades.
Polyamide-imide (PAI)	Valves, gears, pumps, high temperature magnet wire enamels.



The Shower Massage from Water Pik* features NORYL® resin, LEXAN® resin and most recently, VALOX® resin; all products of the Plastics Division of the General Electric Company.

The new mineral-reinforced VALOX resin is used in the demanding swivel bracket assembly.

NORYL resin is used on the unit's handle and shower head housing. The transparent adjustment ring and logo strip are molded from LEXAN resin.

Photo courtesy of Plastics World Magazine

ENGINEERING THERMOPLASTIC RESINS

MANUFACTURING

KNOWN MANUFACTURERS	AC	PCO	PPS	TP	PSO	PPO	PI	PAI	FLUORO-POLYMERS
Allied				X					X
American Hoechst				X					
Amoco Chemical							X	X	
Celanese Engineering Resins	X			X					
Dow Chemical		X							
Dupont	X			X			X		X
Eastman Chemical				X					
GAF				X					
General Electric		X		X		X	X		
Goodyear				X					
ICI Americas									X
Mobay Chemical		X		X					
Pennwalt Corp.									X
Phillips Petroleum			X						
Rohm and Haas				X					
Union Carbide					X				

PRODUCTION AND SALES & CAPTIVE USE[1]

(in millions of pounds and dollars)

YEAR	PRODUCTION	SALES & CAPTIVE USE	SALES (EXCL. CAPTIVE & EXPORTS)
1975	436	433	$385
1976	n.a.	n.a.	n.a.
1977	605	576	486
1978	648	639	579
1979	729	709	699
1980	673	645	715
1981	676	633	806
1982	569	596	755
1983	731	781	979
1984	878	892	1,148

COMPOUND GROWTH RATE OF SALES & CAPTIVE USE	
1974–1984	5.4%
1979–1984	4.7%
1983–1984	14.2%

Source: SPI Committee on Resin Statistics as compiled by Ernst & Whinney

[1] Excludes thermoplastic polyester

n.a. = not available.

DISTRIBUTION BY MAJOR MARKET[1]

(in millions of pounds)

MAJOR MARKET	1980	1981	1982	1983	1984
Transportation	78	76	80	123	136
Packaging	1	1	1	2	2
Building & Construction	86	96	82	76	101
Electrical/Electronic	216	211	192	275	305
Consumer/Institutional	32	37	45	82	90
Industrial/Machinery	55	58	52	75	88
Other	42	34	18	26	70
Exports	106	120	126	122	100
Total	645	633	596	781	892

Source: Industry estimates.

[1] Excludes thermoplastic polyester

U.S. SALES OF FLUOROPOLYMER RESINS (GRANULAR TYPE ONLY)
(in thousands of pounds)

	1980	1981	1982	1983	1984
Virgin, First Quality	7,310	7,699	5,651	6,898	7,969
Filled Resin, including colors	2,846	3,265	2,283	3,131	4,061
Miscellaneous lubricants, release compounds, etc.[1]	3,349	3,503	2,493	2,524	3,034
Total	13,505	14,467	10,427	12,553	15,064

[1] Includes broad specification second quality.
Source: SPI's Fluoropolymers Division.

COMPOUND GROWTH RATE
1979–1984

Virgin, First Quality	0.4%
Filled resin, including colors	3.9%
Miscellaneous lubricants, release compounds, etc.	– 1.3%
Total	0.9%

SUPPLIERS OF GRANULAR PTFE RESINS
Allied Chemical Corp.
American Hoechst Corp.
Custom Compounding
E.I. duPont de Nemours & Co.
ICI Americas
LNP Corporation
Mikro Technik
Montedison USA

FLUOROPOLYMERS
TYPICAL APPLICATIONS

Plenum cable
Non-stick coatings
Wire ties

Chemical processing equipment
Filter housings
Valves

Electrical components
Tower packings
Heat-shrinkable tubing

The pump body and parts of this submersible pump were injection molded from SoLef® PVDF supplied by Soltex Polymer Corp.

HIGH DENSITY POLYETHYLENE

MANUFACTURING

KNOWN MANUFACTURERS	ESTIMATED CAPACITY AS OF DECEMBER 31:[1] (millions of pounds) 1984	1985
Allied Corp.	750	750
American Hoechst Corp.	250	250
Amoco Chemicals Corp.	340	340
Chemplex Company (now NORCHEM)	350	350
Dow Chemical U.S.A.	400	400
DuPont, E.I. de Nemours & Co.	900	900
Exxon Chemical USA[2]	0-150	0-150
Gulf Oil Chemicals (now Chevron)	570	570
Himont U.S.A.	30	30
Mobil Chemical Co.	100	200
Phillips Petroleum Co.	1,400	1,400
Soltex Polymers	900	900
Union Carbide Corp.[2]	1,950–2,100	1,950–2,100
U.S. Industrial Chemicals Co.	875	875
Total[2]	8,815–9,115	8,915–9,215

[1] Includes dual HDPE/LLDPE capacity.

[2] Range takes into account swing capacity between HDPE/LLDPE.

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

UTILIZATION RATE (%)	
1975	70.6
1976	79.9
1977	84.8
1978	85.8
1979	94.1
1980	74.4
1981	78.3
1982	76.5
1983	82.6
1984	84.6

PRODUCTION AND SALES & CAPTIVE USE

(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1975	2,468	2,305
1976	3,125	3,127
1977	3,652	3,557
1978	4,201	4,165
1979	5,010	4,893
1980	4,405	4,394
1981	4,695	4,683
1982	4,928	5,024
1983	5,691	5,707
1984	6,085	5,949
Compound Growth Rate 1974–1984	7.9%	8.3%

PERCENT OF TOTAL U.S. SALES & CAPTIVE USE	
1975	10.89
1976	11.59
1977	11.44
1978	11.88
1979	12.64
1980	12.49
1981	12.67
1982	14.31
1983	14.09
1984	13.73

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

HIGH DENSITY POLYETHYLENE
DOMESTIC CONSUMPTION BY END-USE
(in millions of pounds)

END-USE	1980	1981	1982	1983	1984
Film (12 mils & below)	201	281	288	375	371
Sheet (over 12 mils)	55	52	64	76	121
Injection molding	938	997	1,102	1,188	1,191
Wire & cable	106	111	110	112	123
Extrusion coating	28	33	16	n.a.	n.a.
Blow molding	1,573	1,696	1,714	1,808	2,079
Pipe & conduit	369	408	395	471	473
Other extruded products	24	18	25	42	45
All other uses	573	626	633	634	850
Total	3,867	4,222	4,347	4,706	5,253

n.a.=not available.
Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

MAJOR MARKET	1980	1981	1982	1983	1984
Transportation	85	63	49	121	*
Packaging	2,049	2,367	2,565	2,591	2,954
Building/Construction	428	486	441	518	513
Electrical/Electronic	167	146	142	123	149
Furniture/Furnishings	*	*	*	*	*
Consumer & Institutional	495	482	421	526	488
Industrial/Machinery	*	102	95	109	161
Adhesives, Inks & Coatings	—	*	*	*	*
All Other	644	576	634	718	988
Exports	526	461	677	1,001	696
Total	4,394	4,683	5,024	5,707	5,949

*Included in all other
Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

HIGH DENSITY POLYETHYLENE

TYPICAL APPLICATIONS

Grocery bags
Bottles
Agricultural tanks
Florist tissue
Cables
Gasoline tanks
55-gal. drums
Shipping containers
Seating

Garbage is dumped directly into Toter™ containers made by Applied Products from Marlex high-density polyethylene supplied by Phillips Chemical Company, a subsidiary of Phillips Petroleum Company. The 90-gallon Toters, like the one pictured above, hold more than four conventional metal garbage cans and are easily rolled out to the curb for collection.

LATEX MATERIALS

SIGNIFICANT PRODUCERS*

American Synthetic Rubber	Goodyear Tire & Rubber	Polysar Corp.
Dow Chemical	W.R. Grace	Reichhold Chemicals
General Tire & Rubber	Morton Chemical	Union Chemical

* Those producers in the SPI statistical report.

Production by product type and end-use is as follows:

PRODUCT TYPE	APPROXIMATE % OF TOTAL
Polyvinyl acetate homopolymers and copolymers	48
Styrene/butadiene polymers	45
All other	7
	100

END-USE	APPROXIMATE % OF TOTAL
Export	1
Domestic	99
Paint & coatings	17
Adhesives, caulks, sealants	17
Paper treating	2
Paper coating	26
Textile treating	2
Carpet backing	20
Nonwoven	4
Other	11
	100

STYRENE BUTADIENE & OTHER STYRENE BASED LATEXES

Significant producers are: Dow, General Tire & Rubber, Goodyear, W.R. Grace, Monsanto, Morton Industries, Occidental, Polysar, Reichhold, Union Chemical and USS Chemicals.

PRODUCTION AND SALES & CAPTIVE USE

(thousands of pounds)

		SALES & CAPTIVE USE*				
Year	Production	Paper Treating	Textile Treating	Carpet Backing	All Other	Total
1980	631,816	27,445	24,734	293,059	286,805	632,043
1981	674,188	32,024	28,152	258,740	331,617	650,533
1982	510,160	24,211	12,829	199,461	267,760	504,261
1983	701,673	26,884	19,438	298,649	353,773	698,744
1984	745,109	24,400	15,483	315,811	393,302	748,996

* Data may not be comparable due to variations in participation.

Source: Monthly Statistical Report, SPI Committee on Resin Statistics as compiled by Ernst & Whinney.

LOW DENSITY POLYETHYLENE

MANUFACTURING

KNOWN MANUFACTURERS	ESTIMATED CAPACITY AS OF DECEMBER 31[1]: (millions of pounds) 1984	1985
Chemplex Company (now NORCHEM)	500	500
Dow Chemical U.S.A.	1,600	1,600
DuPont, E.I. de Nemours & Co.	700	700
Eastman Chemical Products	600	600
El Paso Chemical Co.	400	400
Exxon Chemical U.S.A.[2]	1,150–1,300	1,150–1,300
Gulf Oil Chemicals (now Chevron)	900	900
Mobil Chemical Co.	775	775
Northern Petrochemical Co. (now NORCHEM)	700	700
Union Carbide Corp.[2]	1,950–2,100	1,950–2,100
U.S. Industrial Chemicals Co.	800	800
Total[2]	10,075–10,375	10,075–10,375

[1] Includes Linear Low Density [2] Range takes into account dual HDPE/LLDPE capacity not dedicated.

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

UTILIZATION RATE (%)	
1975	72.6
1976	82.9
1977	81.8
1978	88.9
1979	97.7
1980	86.1
1981	78.8
1982	80.2
1983	93.0
1984	88.7

PRODUCTION AND SALES & CAPTIVE USE

(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE	PERCENT OF TOTAL U.S. SALES & CAPTIVE USE	
1975	4,743	4,725	1975	22.33
1976	5,813	5,765	1976	21.37
1977	6,471	6,488	1977	20.86
1978	7,111	7,147	1978	20.38
1979	7,793	7,815	1979	20.19
1980	7,291	7,467	1980	21.22
1981	7,693	7,516	1981	20.34
1982	7,503	7,687	1982	21.89
1983	8,041	8,045	1983	19.86
1984	8,413	8,416	1984	19.43
Compound Growth Rate 1974–1984	3.5%	3.4%		

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

LOW DENSITY POLYETHYLENE
DOMESTIC CONSUMPTION BY END-USE
(in millions of pounds)

END-USE	1980	1981	1982	1983	1984
Film (12 mils & below)	4,004	4,077	4,209	4,628	4,689
Sheet (over 12 mils)	18	14	18	n.a.	n.a.
Injection molding	519	524	507	657	612
Wire & cable	335	347	278	310	368
Extrusion coating	517	564	544	573	640
Blow molding	65	60	42	42	43
Pipe & conduit	22	25	23	25	27
Other extruded products	56	60	46	92	95
All other uses	784	862	876	800	968
Total	6,320	6,533	6,543	7,127	7,442

n.a.=not available
Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET
(in millions of pounds)

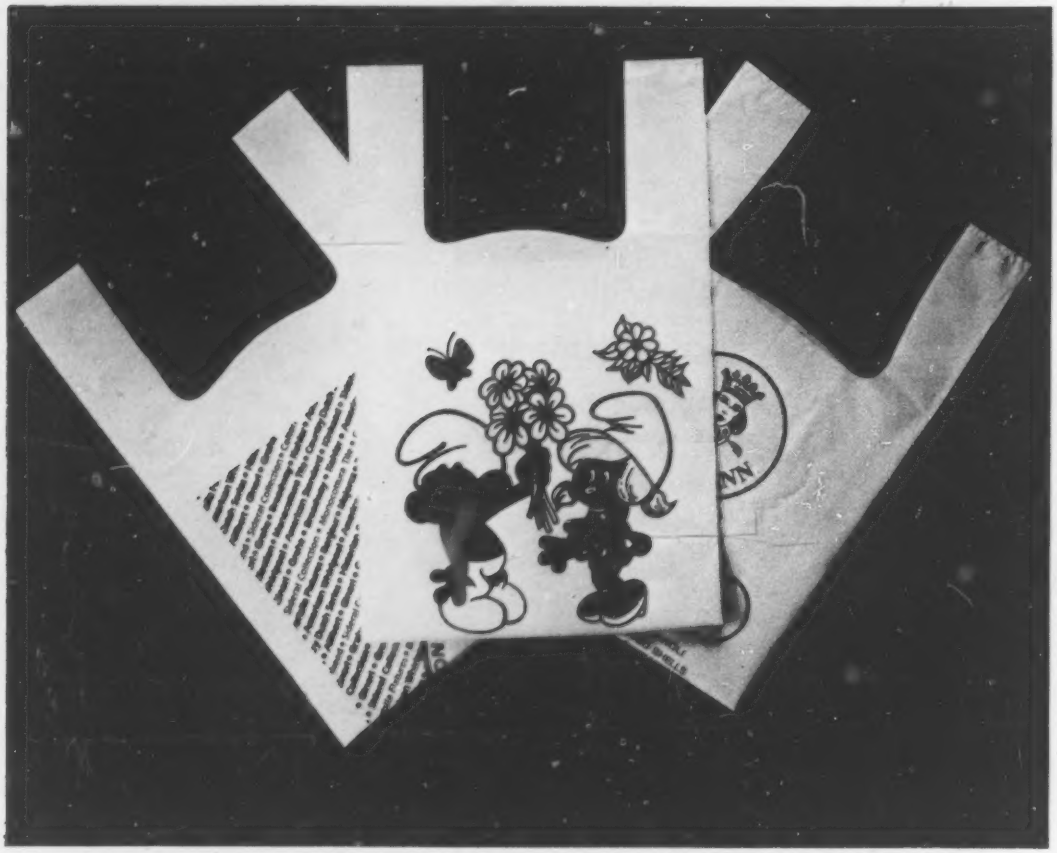
MAJOR MARKET	1980	1981	1982	1983	1984
Transportation	*	53	*	*	*
Packaging	4,582	4,602	4,623	5,377	5,393
Building/Construction	186	148	225	226	313
Electrical/Electronic	416	431	345	374	430
Furniture/Furnishings	15	15	*	*	4
Consumer & Institutional	570	598	487	560	666
Industrial/Machinery	*	*	*	*	*
Adhesives, Inks & Coatings	*	*	46	*	67
All Other	551	685	817	589	569
Exports	1,147	984	1,144	919	974
Total	7,467	7,516	7,687	8,045	8,416

* Included in all other
Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

LOW DENSITY POLYETHYLENE

TYPICAL APPLICATIONS

Stretch wrap	Squeeze bottles	Closures
Diaper liners	Housewares	Pipe
Household cling wrap	Lids	Toys



Merchandising sacks/bags made from linear low density polyethylene supplied by Eastman Chemical Products.

NYLON

MANUFACTURING

KNOWN MANUFACTURERS	ESTIMATED CAPACITY AS OF DECEMBER 31: (millions of pounds) 1984	1985
Allied Corp.	85	95
Badische Corp.	20	20
Belding Chemical Industries	6	6
Celanese Engineering Resins Co.	40	40
Custom Resins, div. Bemis Co.	18	20
DuPont, E.I. de Nemours & Co.	210	230
Monsanto Company	80	80
Nylon Corp. of America	16	16
Rilsan Corp.	18	22
Shakespeare Co.	4	4
Wellman, Inc.	14	14
Total	511	547

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

UTILIZATION RATE (%)	
1975	56.5
1976	80.2
1977	70.8
1978	74.5
1979	79.8
1980	64.0
1981	70.6
1982	53.1
1983	74.7
1984	77.5

PRODUCTION AND SALES & CAPTIVE USE
(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1975	135	143
1976	247	221
1977	254	250
1978	275	278
1979	327	315
1980	274	271
1981	312	288
1982	228	247
1983	321	329
1984	396	389
COMPOUND GROWTH RATE		
1974–1984	6.9%	7.8%

NYLON

	PERCENT OF TOTAL U.S. SALES & CAPTIVE USE
1975	0.68
1976	0.82
1977	0.80
1978	0.79
1979	0.81
1980	0.77
1981	0.78
1982	0.70
1983	0.81
1984	0.90

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DOMESTIC CONSUMPTION BY END-USE

(in thousands of pounds)

END-USE	1980	1981	1982	1983	1984
Automotive and truck	77,972	89,115	69,909	109,949	147,500
Electrical and Electronic[1]	34,792	32,857	28,870	36,144	45,247
Appliances	7,061	8,549	6,847	6,804	6,752
Film and Coating	27,918	28,740	31,879	40,156	43,014
Wire and Cable	16,824	18,999	15,898	18,733	20,913
Monofilament	11,928	15,593	10,126	15,184	15,283
Consumer[2]	21,120	16,533	14,967	20,187	19,547
Industrial/Machinery	n.a.	n.a.	13,733	27,853	34,111
Others	50,434	59,159	38,296	30,043	30,978
Total	248,049	269,545	230,525	305,053	363,345

[1]Includes electrical and electronic applications not assignable to automotive and truck or appliance markets.
[2]Includes such items as housewares, brushes, combs, sporting goods, cameras and toys.
n.a. = not available.
Source: SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET

(in millions of pounds)

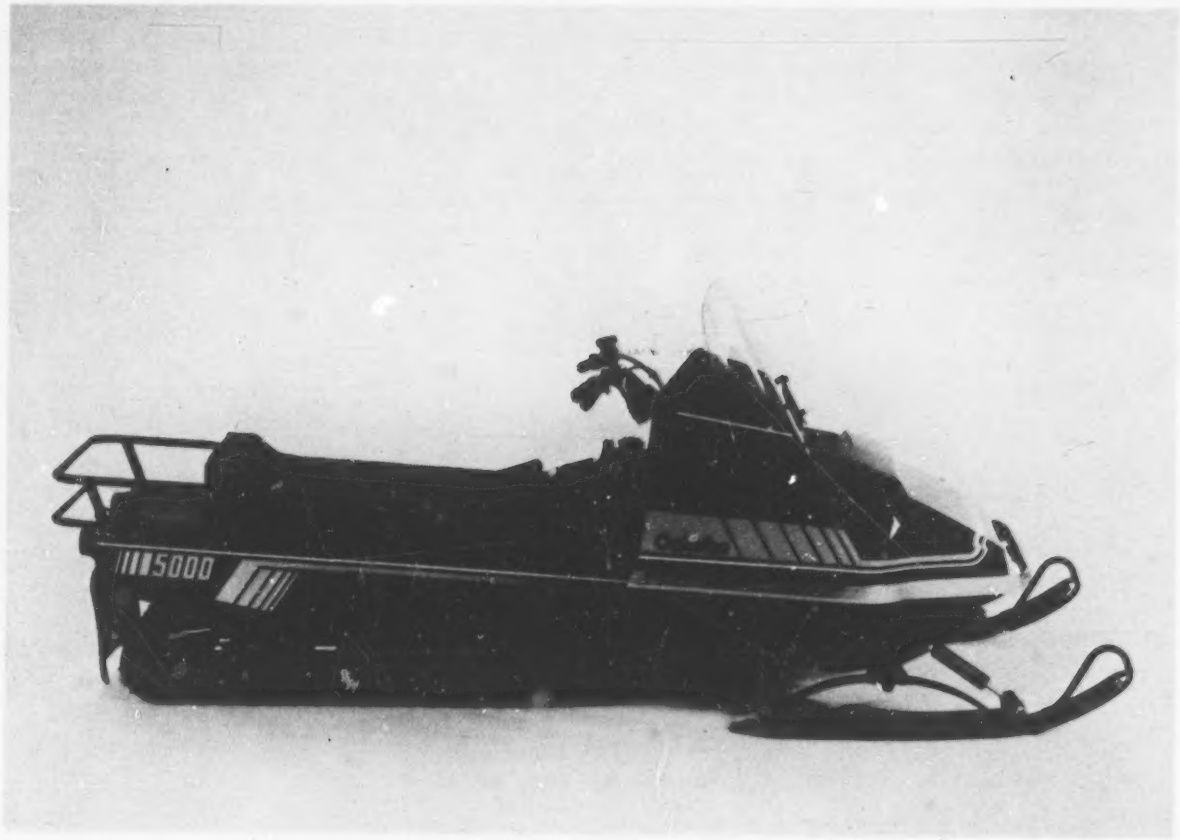
MAJOR MARKET	1980	1981	1982	1983	1984
Transportation	81	92	74	109	156
Packaging	28	32	33	40	38
Building/Construction	*	*	*	*	*
Electrical/Electronic	53	57	50	60	73
Furniture/Furnishings	8	8	*	9	6
Consumer & Institutional	17	17	13	*	*
Industrial/Machinery	20	26	21	28	38
Adhesives, Inks & Coatings	*	*	*	*	*
All Others	41	37	38	59	52
Exports	23	19	18	24	26
Total	271	288	247	329	389

*Included in all other.

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

NYLON
TYPICAL APPLICATIONS

Electrical connectors
Fender extensions
Brush bristles
Wire jackets
Power tool housings
Fishing line
Emission cannisters
Cooking bags
Sutures



NYRIM nylon block copolymers by Monsanto gives the Ockelbo arctic snowmobile underbody panel rigidity without adding extra weight.

POLYPROPYLENE

MANUFACTURING

KNOWN MANUFACTURERS	ESTIMATED CAPACITY AS OF DECEMBER 31: (millions of pounds) 1984	1985
Amoco Chemicals Co.	600	600
ARCO Chemicals Co. (now Cosden)	475	475
Eastman Chemical Products, Inc.	140	140
El Paso Chemical Co.	325	325
Exxon Chemical U.S.A.	550	550
Gulf Oil Chemicals Company (now Chevron)	400	400
Himont U.S.A.	1,320	1,490
Northern Petrochemical Company (now Norchem)	220	220
Phillips Petroleum Company	250	250
Shell Chemical Company	625	800
Soltex Polymer Corp.	220	220
USS Chemicals Co.	500	500
Total	5,625	5,970

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

UTILIZATION RATE (%)	
1975	62.6
1976	83.0
1977	82.5
1978	66.8
1979	76.3
1980	70.2
1981	78.2
1982	68.3
1983	84.1
1984	87.8

PRODUCTION AND SALES & CAPTIVE USE

(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1975	1,902	1,903
1976	2,632	2,536
1977	2,747	2,698
1978	3,074	3,055
1979	3,841	3,894
1980	3,648	3,714
1981	3,955	3,888
1982	3,477	3,623
1983	4,434	4,464
1984	4,940	4,816
COMPOUND GROWTH RATE		
1974–1984	8.2%	8.1%

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

POLYPROPYLENE

	PERCENT OF TOTAL U.S. SALES & CAPTIVE USE
1975	8.99
1976	9.40
1977	8.67
1978	8.71
1979	10.06
1980	10.56
1981	10.52
1982	10.32
1983	11.02
1984	11.12

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DOMESTIC CONSUMPTION BY END-USE

(in millions of pounds)

END-USE	1980	1981	1982	1983	1984
Injection molding, total	1,119	1,243	1,073	1,232	1,290
Appliances	87	94	72	96	121
Consumer products	301	359	273	301	292
Rigid packaging	225	266	291	351	360
Transportation	252	247	225	293	316
All other injection molding	254	277	212	191	201
Blow molding	63	65	68	90	105
Film (10 mils & below)	298	303	290	364	401
Sheet	36	35	19	33	52
Other extruded products (including wire & cable, pipe & conduit, and extrusion coating)	84	99	93	106	112
Fiber & filaments	963	1,036	866	1,221	1,338
All other uses	472	421	476	618	736
Total	3,035	3,202	2,885	3,664	4,034

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as complied by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET

(in millions of pounds)

MAJOR MARKET	1980	1981	1982	1983	1984
Transportation	230	266	199	293	233
Packaging	720	812	757	845	901
Building/Construction	*	*	31	22	36
Electrical/Electronic	196	248	161	242	289
Furniture/Furnishings	727	813	772	983	1,123
Consumer & Institutional	505	487	421	580	624
Industrial/Machinery	52	56	*	*	*
Adhesives, Inks & Coatings	*	*	*	*	*
All Other	604	521	545	599	828
Exports	680	685	737	800	782
Total	3,714	3,888	3,623	4,464	4,816

*Included in all other.

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

POLYPROPYLENE
TYPICAL APPLICATIONS

Retort pouches
Tobacco wrap
Bottles
Battery cases
Carpet backing
Threaded caps
Filter plates
Toys
Microwave oven containers

LIGHTWEIGHT GARDEN SPRAYERS that will not rust or corrode are available in several capacities from Acme Burgess, Inc. The tanks are injection-molded from extra-high-impact-grade Tenite® polypropylene, supplied by Eastman Chemical Products, Inc. Safety features include a color-coded safety/pressure valve that automatically releases excess pressure.

Photo courtesy of Plastics World Magazine

POLYSTYRENE

MANUFACTURING

KNOWN MANUFACTURERS	ESTIMATED CAPACITY AS OF DECEMBER 31: (millions of pounds) 1984	1985
A & E Plastic Pak	50	50
American Hoechst Corp.	600	600
Amoco Chemicals Corp.	400	400
ARCO Chemicals Co.	500	500
Asoma Chemicals, Inc.	45	45
BASF Wyandotte Corp.	180	180
Cosden Oil & Chemical Company	450	450
Dart Container	40	40
Dow Chemical Corp.	1,000	1,000
Georgia Pacific	60	60
Gulf Oil Chemicals	400	400
Huntsman Chemical Co. (incl. Russtek & Goodson)	390	405
Kama Corp	40	40
Mobil Chemical Corp.	350	350
Monsanto Company	700	700
Polysar Group	300	300
Texstyrene Plastic Co.	90	90
Vititek	5	5
Total	5,600	5,615

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

	UTILIZATION RATE (%)
1975	51.5
1976	61.0
1977	66.7
1978	75.9
1979	77.0
1980	67.1
1981	70.2
1982	61.7
1983	68.7
1984	70.0

PRODUCTION AND SALES & CAPTIVE USE

(millions of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1975	2,662	2,640
1976	3,195	3,145
1977	3,446	3,557
1978	3,823	3,870
1979	4,005	3,997
1980	3,521	3,518
1981	3,621	3,604
1982	3,191	3,200
1983	3,567	3,606
1984	3,838	3,836
COMPOUND GROWTH RATE		
1974–1984	1.3%	1.8%

POLYSTYRENE

	PERCENT OF TOTAL U.S. SALES & CAPTIVE USE
1975	12.48
1976	11.66
1977	11.44
1978	11.04
1979	10.32
1980	10.00
1981	9.75
1982	9.11
1983	8.90
1984	8.86

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DOMESTIC CONSUMPTION BY END-USE

(in millions of pounds)

END-USE	1980	1981	1982	1983	1984
Straight Polystyrene[a]	1,761	1,793	1,669	1,811	1,959
Rubber-Modified Polystyrene[a]	1,757	1,811	1,531	1,718	1,776
Total	3,518	3,604	3,200	3,529	3,735
Molding	1,596	1,638	1,368	1,516	1,436
Extrusion	1,083	1,142	1,060	1,238	1,468
Expandable Polystyrene Beads	431	416	426	440	487
All Other Uses	240	257	251	335	344
Total Domestic	3,350	3,453	3,105	3,529	3,735

[a]Includes exports 1980–1982

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET

(in millions of pounds)

MAJOR MARKET	1980	1981	1982	1983	1984
Transportation	13	16	4	12	*
Packaging	1,349	1,494	1,288	1,486	1,540
Building/Construction	277	273	289	294	385
Electrical/Electronic	301	360	311	307	351
Furniture/Furnishings	74	62	39	47	26
Consumer & Institutional	779	756	745	820	754
Industrial/Machinery	*	*	*	*	*
Adhesives, Inks & Coatings	*	*	*	*	—
All Other	557	493	429	563	679
Exports	168	150	95	77	101
Total	3,518	3,604	3,200	3,606	3,836

*Included in all other.

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

POLYSTYRENE
TYPICAL APPLICATIONS

Disposable serviceware
Pallets
Trays
Video cassettes
Appliance parts
Roofing insulation
Business machines
Syringes
Egg cartons

One-piece instrument panel substrates molded out of DYLARK® styrene copolymer from ARCO Chemical meet the challenge for heat resistance in Ford Motor Company's Tempo automobiles.

POLYVINYL CHLORIDE

MANUFACTURING

KNOWN MANUFACTURERS	ESTIMATED CAPACITY AS OF DECEMBER 31: (millions of pounds) 1984	1985
Air Products & Chemicals	500	500
Borden Chemical Company, The	600	800
Certain-Teed Products Corp.	220	220
Formosa Plastics	800	850
General Tire & Rubber Company (now GenCorp)	120	—
Georgia-Gulf Corp.	850	850
B.F. Goodrich Chemical Company, The	1,800	1,800
Goodyear Tire & Rubber Company, The	70	70
Keysor-Century Corp.	50	50
Occidental Chemical Co.	600	600
Shintech, Inc.	920	920
Tenneco Chemicals	950	965
Union Carbide Corp.	125	125
Vista Polymers	715	715
Total	8,320	8,465

Source: Individual company figures are derived from published company reports, announcements to the trade press and other published trade sources.

	UTILIZATION RATE (%)
1975	65.4
1976	80.0
1977	82.8
1978	90.8
1979	86.3
1980	76.8
1981	75.8
1982	72.1
1983	79.2
1984	81.3

PRODUCTION AND SALES & CAPTIVE USE

YEAR	PRODUCTION (millions of pounds)	SALES & CAPTIVE USE (millions of pounds)		PERCENT OF TOTAL U.S. SALES & CAPTIVE USE
1975	3,648	3,615	1975	17.08
1976	4,716	4,638	1976	17.19
1977	5,253	5,232	1977	16.82
1978	5,723	5,810	1978	16.57
1979	6,119	6,138	1979	15.85
1980	5,470	5,407	1980	15.37
1981	5,707	5,601	1981	15.16
1982	5,326	5,455	1982	15.54
1983	6,066	6,152	1983	15.19
1984	6,760	6,798	1984	15.69
Compound Growth Rate				
1974–1984	3.4%	3.7%		

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

POLYVINYL CHLORIDE
DOMESTIC CONSUMPTION BY END-USE

(in millions of pounds)

End-use	1980	1981	1982	1983	1984
Calendering, total	623	666	594	682	720
Flooring	138	147	149	160	173
Textile	94	73	64	105	91
All other calendering	391	446	381	417	456
Coating, total	370	314	267	361	350
Flooring	125	123	99	149	146
Textile & paper coating	119	100	87	119	107
Protective coatings	67	41	38	45	43
Adhesives & all other coatings	59	50	43	48	54
Extrusion, total	2,978	3,149	3,129	3,496	4,330
Wire & cable	368	367	328	350	411
Film & sheet	253	287	312	309	350
Rigid pipe & tubing (except fittings)	1,865	2,033	2,014	2,273	2,901
All other extrusions	492	462	475	564	668
Molding, total	415	372	364	430	464
Bottles	98	92	103	166	186
Sound records	114	104	112	80	75
Fittings (rigid pipe & tubing)	92	102	99	80	122
All other molding	111	74	50	78	81
Paste processes (except coating), total	154	182	172	166	169
Plastisol formulation	81	99	85	96	93
All other	73	83	87	70	76
Resellers	86	140	147	203	167
All other uses	316	342	217	280	220
Grand total	4,942	5,165	4,890	5,618	6,420

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as complied by Ernst & Whinney.

DISTRIBUTION BY MAJOR MARKET

(in millions of pounds)

Major Market	1980	1981	1982	1983	1984
Transportation	195	177	123	150	163
Packaging	410	424	450	546	619
Building/Construction	2,690	2,891	2,902	3,329	4,134
Electrical/Electronic	539	583	467	386	398
Furniture/Furnishings	216	171	236	289	242
Consumer & Institutional	427	434	356	293	290
Industrial/Machinery	16	19	*	20	19
Adhesives, Inks & Coatings	79	56	*	77	108
All Other	370	410	355	528	447
Exports	465	436	566	534	378
Total	5,407	5,601	5,455	6,152	6,798

*Included in all other.

Source: SPI Committee on Resin Statistics Annual Major Markets Survey.

POLYVINYL CHLORIDE
TYPICAL APPLICATIONS

Food wrap
Flooring
Siding
Pipe
Wall covering
Coatings
Upholstery
Garden hose
Shower curtains

This air vacuum hose for industrial use, called Spiraflex 1300, is made of Goodyear Tire & Rubber Pliovic® PVC resin.

POLYVINYL ACETATE

There are more than 50 producers of polyvinyl acetate, supplied with monomer by such companies as Borden, Celanese Chemical, DuPont, National Starch, Union Carbide, and U.S. Industrial Chemicals.

SALES AND CAPTIVE USE OF VINYL ACETATE MONOMER FOR POLYVINYL ACETATE

(thousands of pounds)

Year	Emulsion Paint	Adhesives	Paper	Textile	Non-woven Binders	Others	Export	Total
1980	224,587	262,431	88,372	33,014	30,991	43,292	18,306	700,993
1981	179,531	263,205	85,465	26,666	29,865	42,357	14,557	641,646
1982	163,470	234,994	94,185	17,250	25,700	26,143	6,081	567,823
1983	210,553	273,751	117,330	22,601	31,212	27,542	5,867	688,856
1984	203,282	275,002	119,528	25,924	30,896	28,767	6,976	690,375

COMPOUND GROWTH RATE TOTAL SALES & CAPTIVE USE	
1979–1984	–1.9%
1983–1984	0.2%

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

POLYVINYL ALCOHOL

The major manufacturers of polyvinyl alcohol in the U.S. are DuPont, Air Products, and Monsanto.

PRODUCTION AND SALES & CAPTIVE USE

(thousands of pounds)

		SALES & CAPTIVE USE		
YEAR	PRODUCTION	DOMESTIC	EXPORT	TOTAL
1980	140,619	115,177	13,151	128,328
1981	138,898	114,355	20,393	134,748
1982	n.a.	n.a.	n.a.	n.a.
1983	132,176	112,230	23,827	136,057
1984	138,465	108,964	29,793	138,757

n.a.=not available.

COMPOUND GROWTH RATE TOTAL SALES & CAPTIVE USE	
1979–1984	–1.3%
1983–1984	2.0%

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

OTHER VINYL RESINS

Producers of these vinyl resins include Dow, DuPont, B.F. Goodrich, W.R. Grace, Monsanto, Morton Industries, Rohm and Haas, Union Carbide and Union Chemical.

PRODUCTION AND SALES & CAPTIVE USE
(thousands of pounds)

YEAR	PRODUCTION	SALES & CAPTIVE USE
1980	196,235	192,638
1981	208,201	198,903
1982	177,225	166,695
1983	185,558	177,844
1984	187,209	186,619

COMPOUND GROWTH RATE OF SALES & CAPTIVE USE	
1979–1984	–2.6%
1983–1984	4.9%

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney.

MISCELLANEOUS THERMOPLASTICS
(millions of pounds)

PRODUCTION

RESIN	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Acrylics	890	773	888	967	1,086	1,142	1,028	1,100	1,131	1,365
Petroleum hydrocarbons	326	299	306	334	319	321	264	272	283	257
Non-nylon polyamides	46	24	31	41	33	35	46	49	49	59
Polyterpenes	18	11	13	14	15	30	41	36	31	36
Rosin modifications	123	64	64	47	41	94	182	275	388	388
Other[1]	20	63	443	115	169	188	406	607	351	442

SALES

RESIN	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Acrylics	676	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	884	812	941
Petroleum hydrocarbons	310	281	293	332	309	301	253	259	262	227
Non-nylon polyamides	41	23	28	40	33	34	42	47	44	56
Polyterpenes	19	10	13	14	15	30	36	35	29	36
Rosin modifications	109	501	63	47	42	85	177	266	325	358
Other[1]	82	727	1,043	862	883	667	791	806	280	261

n.a.=not available
*Included in other

[1]Includes acrylic (sales only 1975–1980), chlorinated polyolefins, coumarone-indene, fluoropolymers, polybutylene, polyphenyl aromatic esters, and other thermoplastics. Thermoplastic polyesters were taken out in 1982.
Source: *Synthetic Organic Chemicals*, U.S. International Trade Commission.

DOMESTIC SALES & USE OF SELECTED THERMOPLASTICS BY PROCESS GRADE

(millions of pounds)

MATERIAL/YEAR	TOTAL	INJECTION MOLDING	EXTRUSION	BLOW MOLDING	OTHER
Grand Total					
1980	23,102	5,218	11,636	2,134	4,114
1981	24,232	5,383	12,252	2,293	4,304
1982	23,259	4,979	11,665	2,383	4,232
1983	26,546	5,778	13,407	2,620	4,741
1984	29,007	5,849	14,918	2,948	5,292
Growth Rate					
1979–1984	2.7%	–0.5%	2.6%	8.9%	3.9%
LD Polyethylene					
1980	6,320	519	4,952	65	784
1981	6,533	524	5,087	60	862
1982	6,543	507	5,118	42	876
1983	7,127	657	5,628	42	800
1984	7,442	612	5,819	43	968
Growth Rate					
1979–1984	1.5%	–1.2%	1.3%	–6.4%	5.5%
HD Polyethylene					
1980	3,867	938	783	1,573	573
1981	4,222	997	903	1,696	626
1982	4,347	1,102	898	1,714	633
1983	4,706	1,188	1,076	1,808	634
1984	5,253	1,191	1,133	2,079	850
Growth Rate					
1979–1984	4.2%	2.1%	5.8%	3.8%	6.0%
Polypropylene					
1980	3,035	1,119	1,381	63	472
1981	3,202	1,243	1,473	65	421
1982	2,885	1,073	1,268	68	476
1983	3,664	1,232	1,724	90	618
1984	4,034	1,290	1,903	105	736
Growth Rate					
1979–1984	4.9%	1.1%	5.9%	11.1%	9.4%
A B S[a]					
1980	859	471	208	—	180
1981	848	488	180	—	180
1982	689	430	111	—	148
1983	900	560	145	—	195
1984	1,000	600	150	—	250
Growth Rate					
1979–1984	–2.3%	0.5%	–13.0%	—	1.2%

[a]ABS estimated 1983–1984.

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney. Industry contacts.

DOMESTIC SALES & USE OF SELECTED THERMOPLASTICS BY PROCESS GRADE (Cont'd)

(millions of pounds)

MATERIAL/YEAR	TOTAL	INJECTION MOLDING	EXTRUSION	BLOW MOLDING	OTHER
Polystyrene					
1980	3,350	1,596	1,083	—	671
1981	3,453	1,638	1,142	—	673
1982	3,105	1,368	1,060	—	677
1983	3,529	1,516	1,238	—	775
1984	3,735	1,436	1,468	—	831
Growth Rate					
1979–1984	–0.5%	–5.5%	2.3%	—	6.0%
Nylon					
1980	248	169	74	—	5
1981	270	178	76	—	16
1982	229	138	71	—	20
1983	305	198	85	—	22
1984	363	243	95	—	25
Growth Rate					
1979–1984	5.0%	4.5%	7.2%	—	1.7%
Thermoplastic Polyester[b]					
1980	481	140	5	335	1
1981	539	150	7	380	2
1982	571	100	10	456	5
1983	697	163	15	514	5
1984	760	200	20	535	5
Growth Rate					
1979–1984	n.a.	n.a.	n.a.	n.a.	n.a.
P V C					
1980	4,942	317	2,978	98	1,549
1981	5,165	280	3,149	92	1,644
1982	4,890	261	3,129	103	1,397
1983	5,618	264	3,496	166	1,692
1984	6,420	277	4,330	186	1,627
Growth Rate					
1979–1984	2.0%	–8.0%	4.3%	17.8%	–2.0%

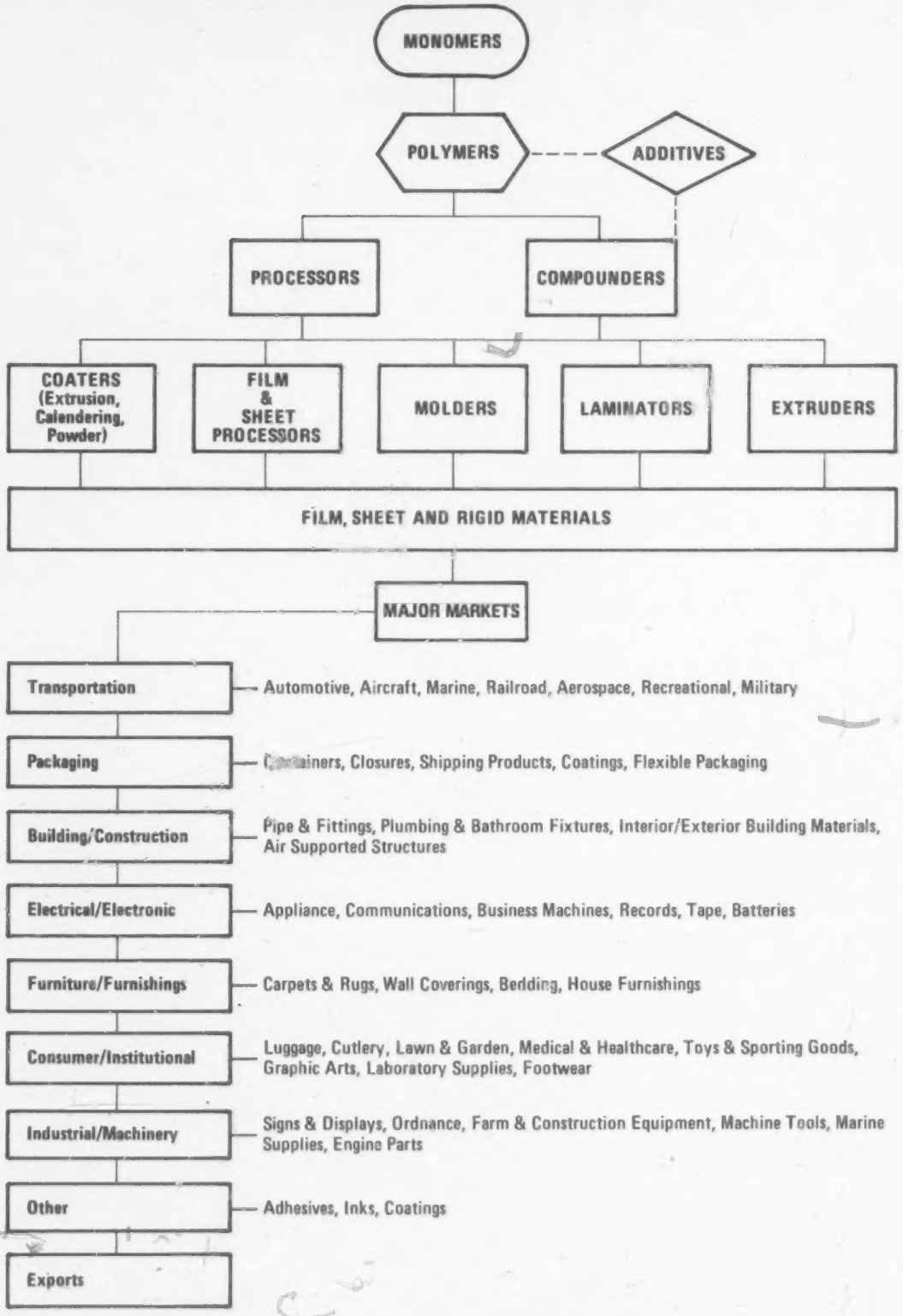
[b]Thermoplastic Polyester estimated 1983–1984.

n.a. = not available.

Source: Monthly Statistical Report, SPI Committee on Resin Statistics, as compiled by Ernst & Whinney. Industry contacts.

FABRICATED PLASTIC PRODUCTS

FLOW CHART: FROM RAW MATERIAL TO FINAL PRODUCT



Source: SPI, Committee on Resin Statistics, *Major Markets Manual.*

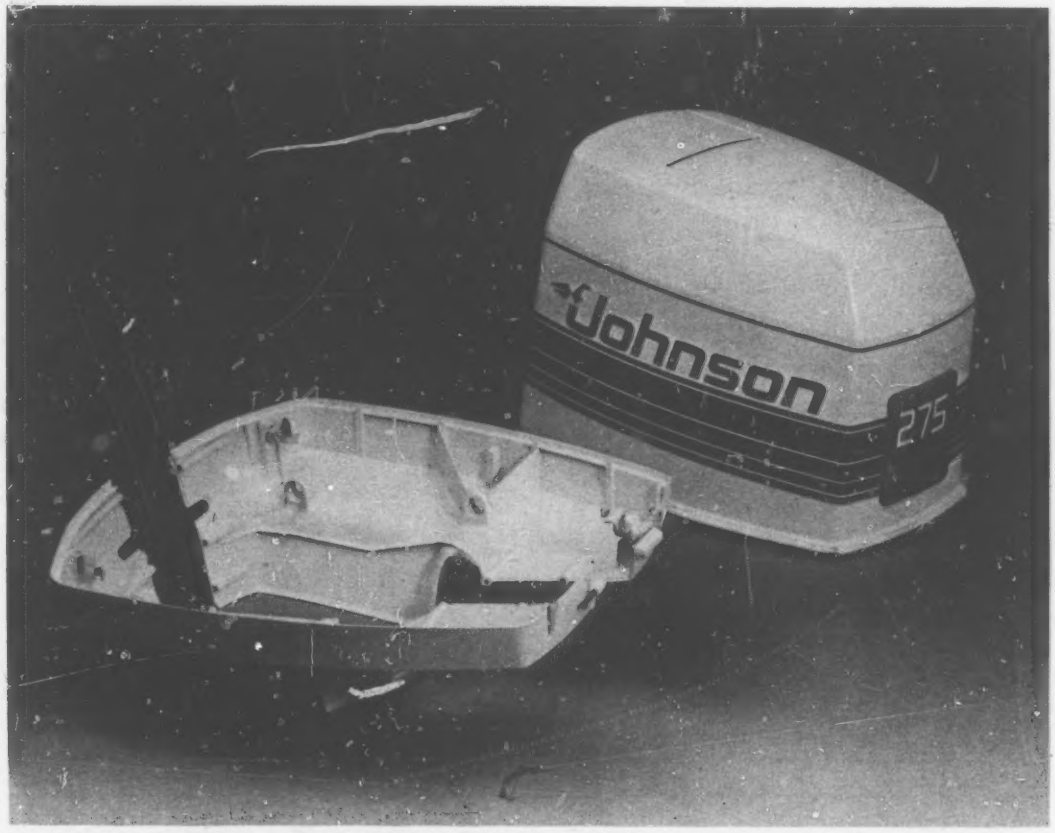
REINFORCED PLASTICS SHIPMENTS BY MARKET

(BOTH THERMOSET & THERMOPLASTIC RESINS)

MARKETS	SHIPMENTS (in millions of pounds)					
	1980	1981	1982	1983	1984[1]	1985[2]
Aircraft & Aerospace	25	28	22	25	29	35
Appliances & Equipment	104	117	82	106	123	130
Construction	287	317	312	400	430	443
Consumer Goods	103	115	84	128	143	149
Corrosion-Resistant Products	252	275	235	288	310	326
Electrical Rods, Tubes, Parts	162	178	140	170	189	205
Marine & Marine Accessories	275	290	230	276	309	325
Land Transportation	416	445	359	458	540	570
Miscellaneous	70	75	64	72	80	86
Total	1,694	1,840	1,528	1,923	2,153	2,269

[1] = estimate
[2] = forecast

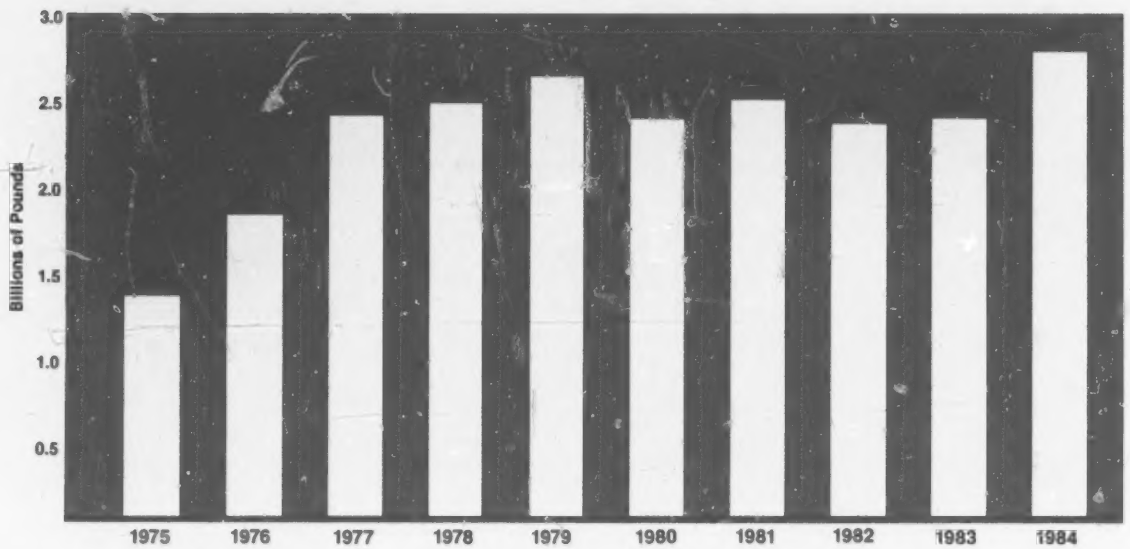
Source: Reinforced Plastics/Composites Institute, SPI.



In its new V-8 engines, Outboard Marine Corp. has extended its reliance on reinforced plastics beyond its established use of preformed glass reinforced polyester for engine shrouds to new two-piece lower motor support covers molded of MFG low-profile 28% fibrous glass and unidirectional glass fiber reinforced polyester sheet molding compound that replaced cast aluminum support covers.

PLASTICS PIPE AND FITTINGS

U.S. PLASTICS PIPE AND FITTINGS SHIPMENTS 1975-1984



Source: SPI Monthly Thermoplastics Pipe & Fittings Report, as compiled by Ernst & Whinney. Industry estimates.

U.S. SHIPMENTS OF THERMOPLASTIC PIPE, TUBE & CONDUIT BY MATERIAL

(in millions of pounds)

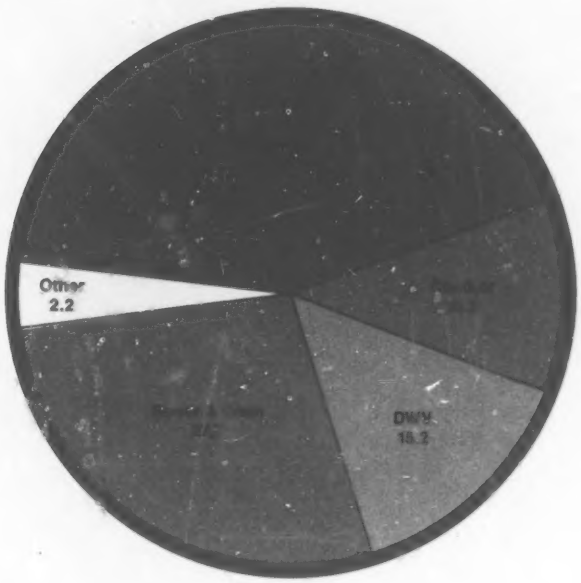
YEAR	TOTAL	PVC	ABS	PE	OTHER
1980	2,409	1,713	125	559	12
1981	2,526	1,834	97	580	15
1982	2,252	1,719	71	447	15
1983	2,368	1,731	88	532	17
1984	2,056	2,002	77	557	20
Growth Rate					
1979–1984	0.6%	1.5%	– 16.1%	1.3%	10.8%

U.S. PLASTIC PIPE SHIPMENTS BY MATERIAL 1984 vs 1983

(in millions of pounds)

MATERIAL	1984	1983	CHANGE	% CHANGE
PVC	2,002	1,731	+ 271	15.7%
ABS	77	88	– 11	– 12.5%
PE	557	532	+ 45	8.5%
Other	20	17	+ 3	17.6%
Total	2,656	2,368	+ 288	12.2%

DISTRIBUTION OF PLASTICS PIPE SHIPMENTS BY APPLICATION — 1984



U.S. SHIPMENTS OF THERMOPLASTIC PIPE, TUBE & CONDUIT BY APPLICATION

(in millions of pounds)

YEAR	TOTAL	PRESSURE	CONDUIT	DWV	SEWER & DRAIN	OTHER
1980	2,409	1,046	370	289	623	79
1981	2,526	1,130	370	289	657	80
1982	2,252	980	318	314	585	55
1983	2,368	919	323	359	703	64
1984	2,656	1,109	348	404	737	58
Growth Rate 1979–1984	0.6%	0.9%	–3.0%	5.2%	1.4%	–12.8%

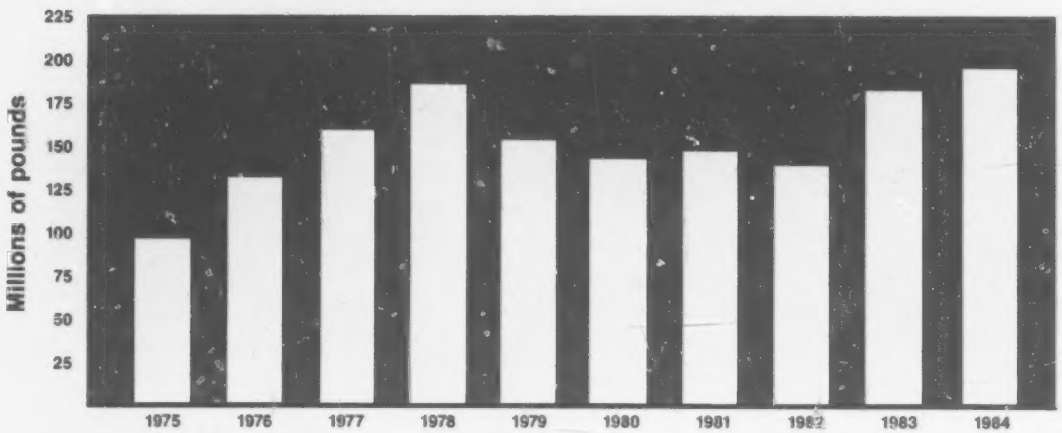
DWV = Drain, Waste & Vent

U.S. PLASTICS FITTINGS BY APPLICATION

(in millions of pounds)

YEAR	TOTAL	PRESSURE	DWV	SEWER & DRAIN	OTHER
1980	142	34	68	19	40
1981	149	38	69	18	24
1982	140	37	67	14	22
1983	185	38	95	17	35
1984	191	39	98	16	38
Growth Rate					
1979–1984	4.0%	1.6%	3.9%	1.3%	8.7%

U.S. PLASTICS FITTINGS SHIPMENTS: 1975–1984



Source: SPI Monthly Thermoplastic Pipe & Fittings Report, as compiled by Ernst & Whinney.

U.S. PLASTICS FITTINGS SHIPMENTS BY MATERIAL

(in millions of pounds)

Year	Total	PVC	ABS	Other*
1980	142	103	30	9
1981	148	113	26	10
1982	140	112	19	9
1983	185	143	25	17
1984	191	152	21	18
Growth Rate				
1979–1984	4.0%	6.9%	−11.2%	12.5%

*Includes polyethylene, chlorinated PVC, polybutylene, styrene rubber, etc.

PLASTIC BOTTLES: PRODUCTION

(in millions of units)

BY TYPE	1979	1980	1981	1982	1983	Growth Rate 1978–1983
Household Chem.	2,845	2,874	2,843	2,855	2,899	0.2%
Industrial Chem. & Spec.	415	315	308	348	387	-3.8%
Toiletries & Cosmetics	2,023	2,176	2,238	2,201	2,405	2.7%
Medicinal & Health	2,114	2,247	2,371	2,257	2,335	4.4%
Food & Beverages	4,586	5,820	6,246	6,868	7,310	24.0%
Automotive & Marine	299	265	211	319	334	12.7%
Not Specified by Kind	507	578	526	651	777	21.0%
Total	12,789	14,275	14,743	15,499	16,447	9.8%

Source: U.S. Dept. of Commerce, Bureau of the Census

EXPLANATION OF TERMS

Household Chemicals— Bleach, dishwashing, laundry, and other detergents; fabric softeners; blow and drain cleaners; dry cleansers; floor care products; soaps (including medicated); window cleaners; air fresheners; household pesticides and garden chemicals; household adhesives; waxes and polishes (including car polish); car wax, wax and polish remover, etc.

Industrial, Agricultural and Specialty Chemicals— Agricultural, industrial, and institutional chemical and cleaning products; photographic chemicals; battery acid; paint and varnish supplies, etc.

Toiletries and Cosmetics— Shampoos and other hair grooming products; talcs and powders; hand, face, and body lotions and ointments; shaving preparations; bath products; perfumes, toilet water, and colognes; personal deodorant, etc.

Medicinal and Health— Oral antiseptics and mouthwashes; laxatives; pharmaceutical lotions, creams, and ointments; pain relievers; vitamins; rubbing alcohols; antacids, etc.

Food and Beverages— Milk; carbonated beverages; noncarbonated beverages such as juices, water, cider, etc.; distilled spirits and other alcoholic beverages; edible oil; and all other food items.

Automotive and Marine— Antifreeze; motor oil; lubricants; defrosters; windshield cleaners; hydraulic fluids; additives, etc.

BY MATERIAL (In millions of pounds)	1979	1980	1981	1982	1983	Growth Rate 1978–1983
HD Polyethylene	1,122	1,077	1,146	1,236	1,249	8.7%
LD & MD Polyethylene	61	77	51	47	58	4.3%
Polyvinyl Chloride	81	98	94	93	118	8.4%
Polypropylene	37	44	52	52	57	n.a.
Polyethylene Terephthalate	*	*	44	411	365	n.a.
Other Resins	185	348	7	6	6	n.a.
Total	1,486	1,644	1,754	1,845	1,853	12.6%

n.a. = not available

*Included in other resins.

PLUMBING FIXTURES: PRODUCTION

(Thousands of units)

LAVATORIES

	Total	Vitreous China	Cast Iron	Other Metals	Plastics[1]
1979	5,349	2,739	783	1,408	419
1980	4,345	2,322	589	992	442
1981	4,062	2,262	534	814	452
1982	3,562	1,887	506	854	315
1983	5,100	2,464	605	1,492	539

BATHTUBS

	Total	Cast Iron	Steel	Plastics
1979	3,197	826	1,068	1,303
1980	2,269	565	848	856
1981	2,291	560	793	938
1982	2,399	545	809	1,045
1983	3,418	600	1,267	1,551

SHOWER STALLS, INC. RECEPTORS

	Total	Metals	Plastics
1979	397	29	368
1980	336	18	318
1981	321	22	299
1982	312	9	303
1983	420	6	414

[1]Includes concrete and other nonmetals.
Source: U.S. Dept. of Commerce, Bureau of the Census.

[1]Includes concrete and other nonmetals.
Source: U.S. Dept. of Commerce, Bureau of the Census.

PRODUCER PRICE INDEXES—PLASTICS PRODUCTS

Plastics Product	Index Base	Dec. 1984 Index	12 Month % Change
Appliances	12/82	95.2	–6.1
Bags, Polyethylene	12/83	102.5	2.5
Bottles	12/82	103.7	1.5
Business Machines	12/82	111.6	8.7
Caps and Closures	12/82	103.4	2.3
Cups, Nonfoam	1/83	104.2	0.7
Dinnerware, Tableware & Kitchenware	12/82	106.1	4.1
Doors, Partitions, Moldings, Windows & Frames, and Decorative Trim	12/82	104.6	1.9
Fixture Tops, Laminated	12/83	112.6	12.6
Flower Pots & Plant Containers	12/82	98.6	n.a.
Foamed Products	12/82	95.4	–5.5
Food Trays	12/82	101.7	–0.8
Footwear, Men's Upper	12/80	104.3	0.5
Footwear, Women's Upper	12/80	102.7	2.1
Gears, Bearings, Bushings, & Cams	12/82	102.7	1.9
Handbags & Purses	6/82	112.7	6.3
Hose	12/81	114.8	14.2
Hospitalware	12/82	111.6	–4.7
Kitchen Cabinets, Custom, Laminated	6/84	102.1	n.a.
Kitchen Cabinets, Stock, Laminated	6/84	102.9	n.a.
Machinery, Blow Molding	4/82	107.7	n.a.
Machinery, Extrusion	12/81	116.5	4.7
Machinery, Injection Molding	12/81	116.4	5.9
Molds for Plastics	6/81	109.5	5.4
Motorboats, Inboard, Cabin Cruisers	12/81	111.2	1.5
Motorboats, Outboard, Runabouts	12/81	112.8	5.4
Motor Vehicle Parts	12/82	103.8	0.5
Panels, Corrugated & Flat	12/82	103.0	3.8
Piping	12/82	101.8	1.6
Plumbing Fixtures	12/82	99.8	n.a.

n.a. = not available
Source: U.S. Dept. of Labor, Bureau of Labor Statistics

MAJOR MARKETS

DEFINITIONS

The primary product groups for each Major Market category are listed below:

A. TRANSPORTATION

Motor Vehicles and Parts: including autos, trucks, buses, motorcycles, and bicycles. Ships, boats and recreational vehicles.

All Other: including railroad equipment, travel trailers, campers, golf carts, snowmobiles, aircraft, military vehicles.

B. PACKAGING

Bottles, Jars, Vials

Food Containers: including disposable cups

Blister and Bubble Containers

Flexible Packaging: including household and institutional refuse bags and film

All Other: including tubes, tape, strapping, drums, caps, baskets, trays, boxes, pallets, shipping crates, pails, buckets, shipping cases.

C. BUILDING AND CONSTRUCTION

Pipe, Conduit and Fittings: including drainage, irrigation, plumbing fixtures, septic tanks

Building Material for all Structures: including siding, flooring, and insulation materials

All Other: including panels, doors, windows, skylights, bathroom units, gratings and railings.

D. ELECTRICAL AND ELECTRONIC

Home and Industrial Appliances: including electrical industrial equipment, wire and cable coverings, communications equipment

Electronic Components: including resistors, magnetic tape, records, and batteries.

E. FURNITURE AND FURNISHINGS

Rigid and Flexible Types: including household and office furniture, bedding, carpets, rugs, backing, curtains, blinds, awnings, lamps, picture frames, wall coverings.

F. CONSUMER AND INSTITUTIONAL PRODUCTS

Non-packaging Disposables

Dinner and Kitchenware: including picnicware

Toys and Sporting Goods

Health Care and Medical Products: including laboratory supplies

Hobby and Graphic Arts Supplies: including photographic equipment and supplies

All Other: including footwear, luggage, buttons, lawn & garden tools, signs and displays, credit cards.

G. INDUSTRIAL/MACHINERY

All Types: including engine and turbine parts, farm and garden machinery, construction and related equipment, machine tools, ordnance and firearms, chemical process equipment.

H. ADHESIVES/INKS/COATINGS

Adhesives and Sealants

All Other: including printing ink, magnet wire enamels, core binders, foundry facings, paper coating and glazing, paints, varnishes, and enamels.

I. RESELLERS/COMPOUNDERS

Sales of Resins Sold to Resellers, Compounders, Converters

Unclassified Sales: including calenderers whose end-use markets cannot be ascertained by the resin supplies, or resin that cannot be classified under any of the Major Market categories listed above.

J. EXPORTS

Sales of Plastic Resin exported from the U.S.

1984 RESULTS

The 1984 data reflect major market plastics resins sales and captive use data compiled by Ernst & Whinney with consumption data being reported by individual resin. The plastics resins categories included in this study are:

THERMOSETS

Epoxy
Polyester, Unsaturated
Urea and Melamine
Phenolic
All Other Thermosets

THERMOPLASTICS

Low Density Polyethylene
High Density Polyethylene
Polypropylene
Acrylonitrile-Butadiene-Styrene (ABS) and Styrene-Acrylonitrile (SAN)
Styrene Butadiene Latexes (SBL), and Other Styrene Based Latexes
OSBL), and Other Styrene Based Polymers (OSBP)
Nylon
Polyvinyl Chloride
Thermoplastic Polyester
All Other Thermoplastics

In addition, sales and captive use of polyurethane are reported separately by Major Markets total only in an appendix to this report.

COMPARISON OF 1984 DATA TO PRIOR YEARS
FIVE YEAR COMPARISON OF RESIN SALES & USE BY MAJOR MARKET*

(millions of pounds, dry weight basis)

MAJOR MARKET	1980	1981	1982	1983	1984
Transportation	1,605	1,573	1,392	1,896	2,109
Packaging	10,003	10,465	10,497	11,813	12,398
Building/Construction	6,424	7,259	7,154	8,552	9,691
Electrical/Electronic	2,453	2,670	2,275	2,514	2,757
Furniture/Furnishings	1,646	1,670	1,556	2,007	2,117
Consumer & Institutional	3,553	3,670	3,269	3,816	3,986
Industrial/Machinery	391	393	241	318	400
Adhesives, Inks & Coatings	2,387	2,572	1,584	1,800	1,993
All Other	3,054	3,259	3,232	3,636	4,080
Exports	3,670	3,425	3,909	4,150	3,796
Total	35,186	36,956	35,109	40,502	43,327

*Note: All figures exclude polyurethane.

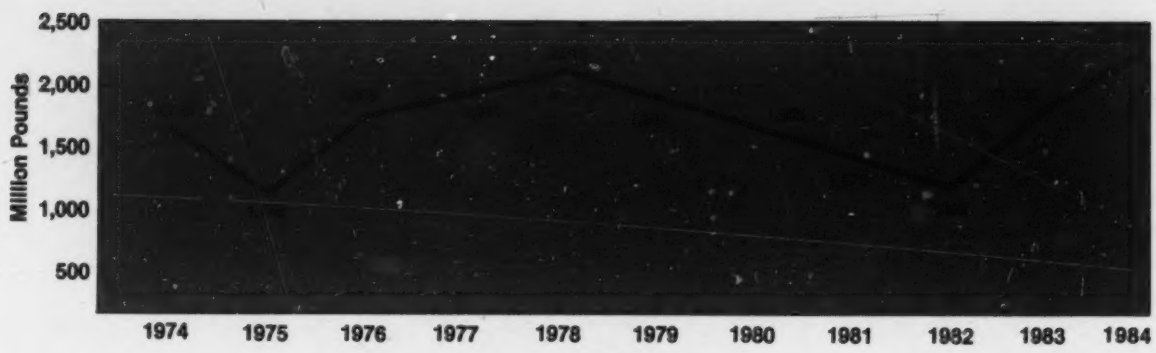
COMPARATIVE PERCENTAGE DISTRIBUTION BY MAJOR MARKET

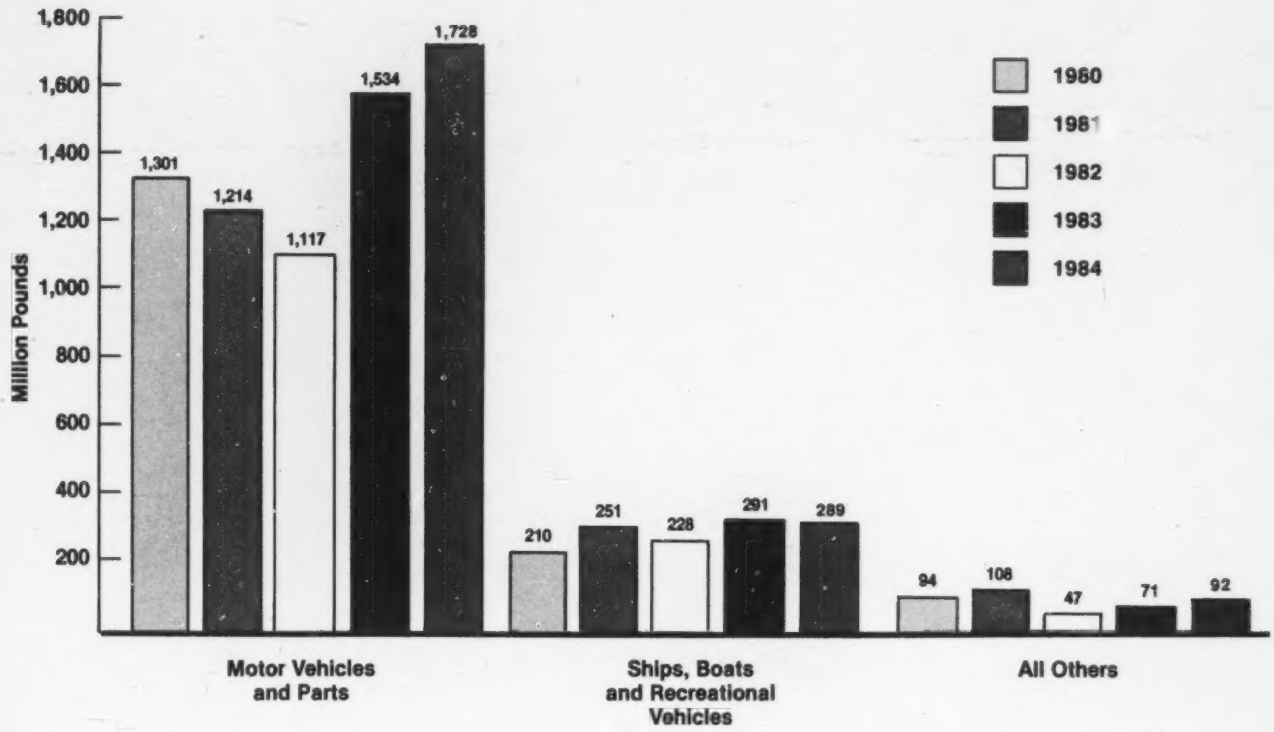
MAJOR MARKET	1980	1981	1982	1983	1984
Transportation	4.6%	4.3%	4.0%	4.7%	4.9%
Packaging	28.4	28.3	29.9	29.2	28.6
Building/Construction	18.3	19.6	20.4	21.1	22.4
Electrical/Electronic	7.0	7.2	6.5	6.2	6.4
Furniture/Furnishings	4.7	4.5	4.4	5.0	4.9
Consumer & Institutional	10.1	9.9	9.3	9.4	9.2
Industrial/Machinery	1.1	1.1	0.7	0.8	0.8
Adhesives, Inks & Coatings	6.8	7.0	4.5	4.4	4.6
All Other	8.6	8.8	9.2	9.0	9.4
Exports	10.4	9.3	11.1	10.2	8.8
Total	100.0%	100.0%	100.0%	100.0%	100.0%

PERCENTAGE CHANGE IN SALES AND USE BY MAJOR MARKET

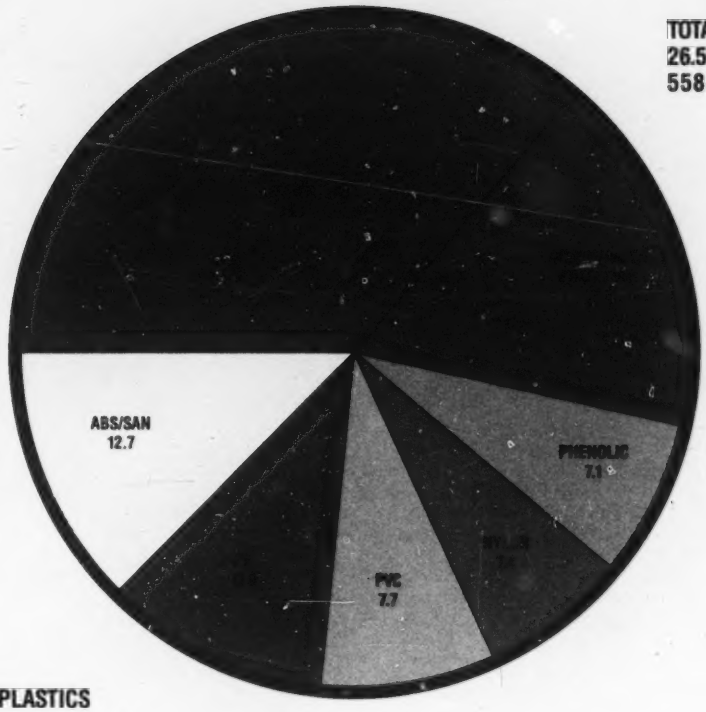
MAJOR MARKET	% CHANGE 1984/1983	% CHANGE 1983/1982	GROWTH RATE 1979–1984
Transportation	11.2%	36.2%	1.8%
Packaging	5.0	12.5	3.7
Building/Construction	13.3	19.5	5.0
Electrical/Electronic	9.7	10.5	–2.0
Furniture/Furnishings	5.5	29.0	2.3
Consumer/Institutional	4.5	16.7	1.2
Industrial/Machinery	25.8	32.0	–5.0
Adhesives/Inks/Coatings	10.7	13.6	–6.6
All Other	12.2	12.5	3.5
Exports	–8.5	6.2	2.0
Total	7.0%	15.4%	2.3

TRANSPORTATION





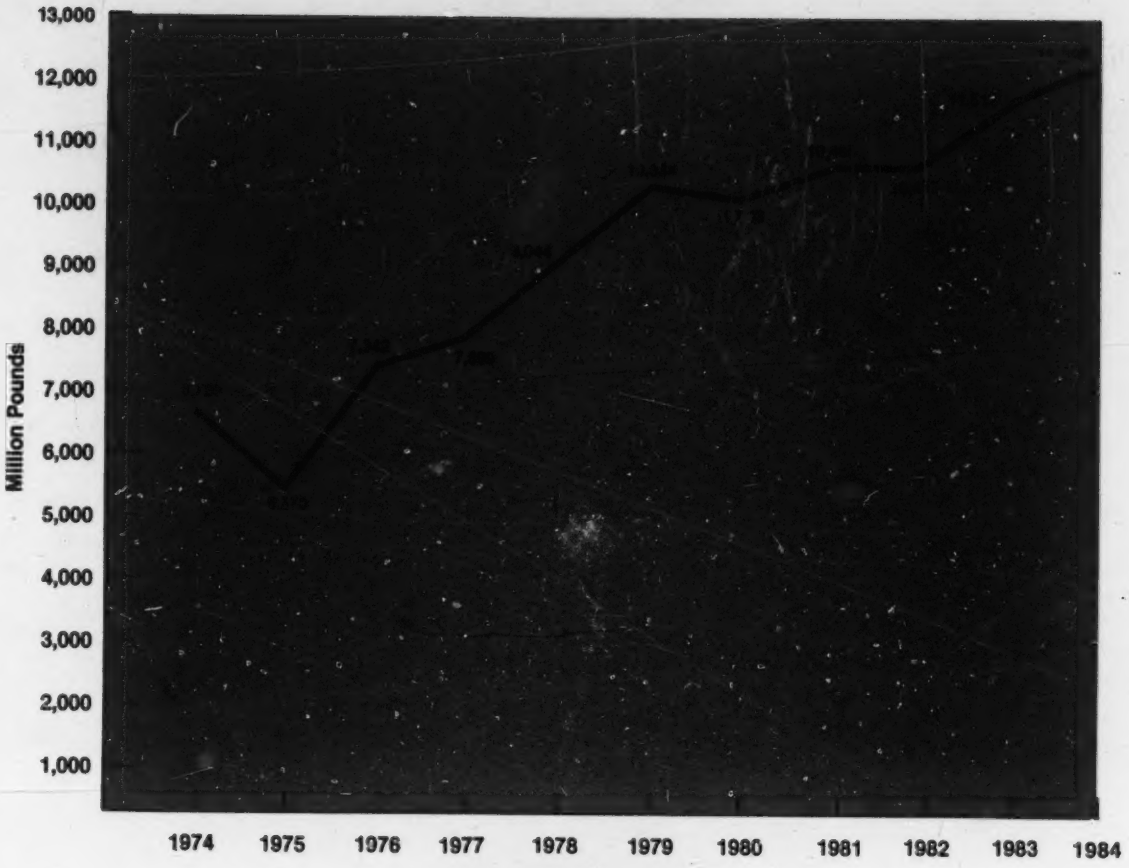
TRANSPORTATION (cont'd)

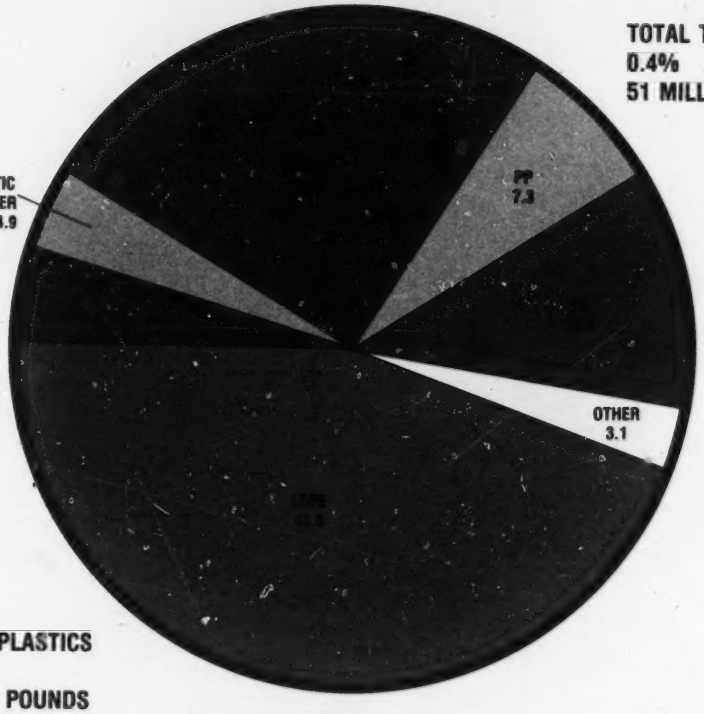


TOTAL THERMOSETS
26.5%
558 MILLION POUNDS

TOTAL THERMOPLASTICS
73.5%
1,551 MILLION POUNDS

PACKAGING

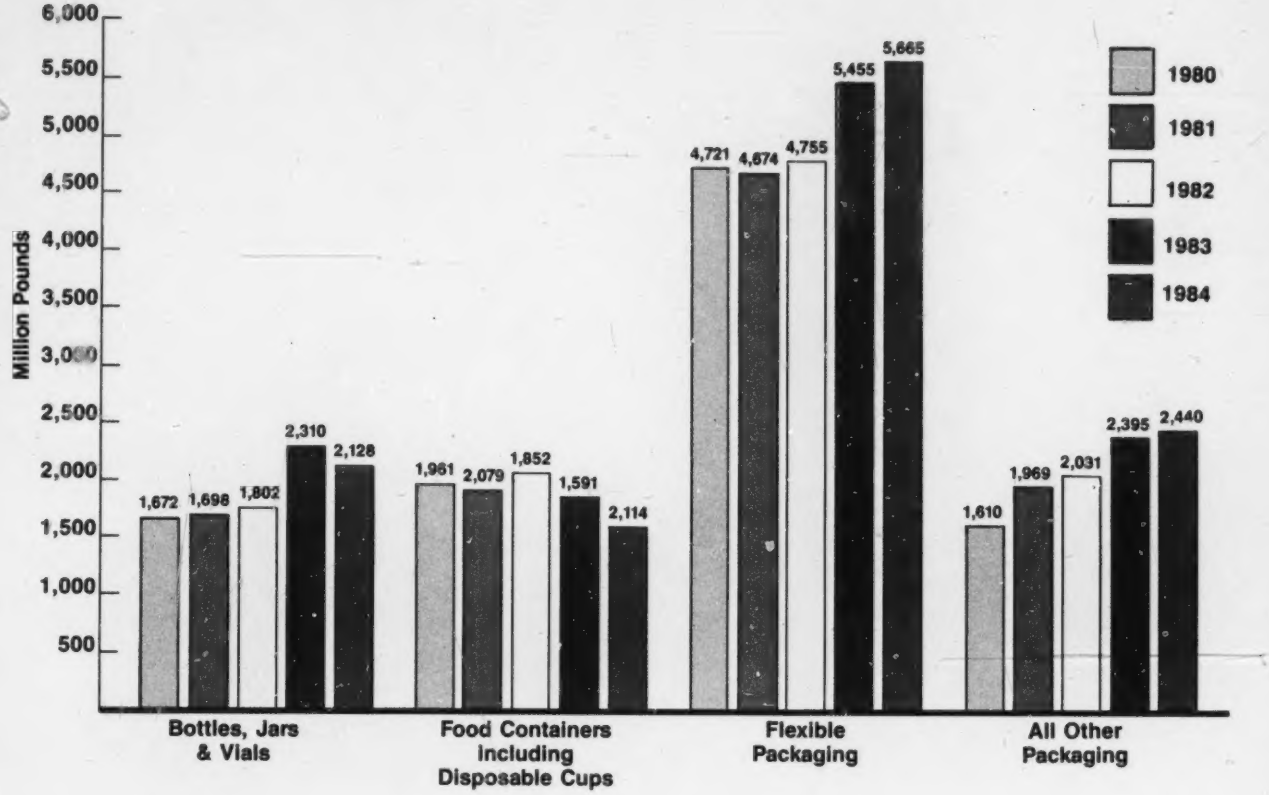




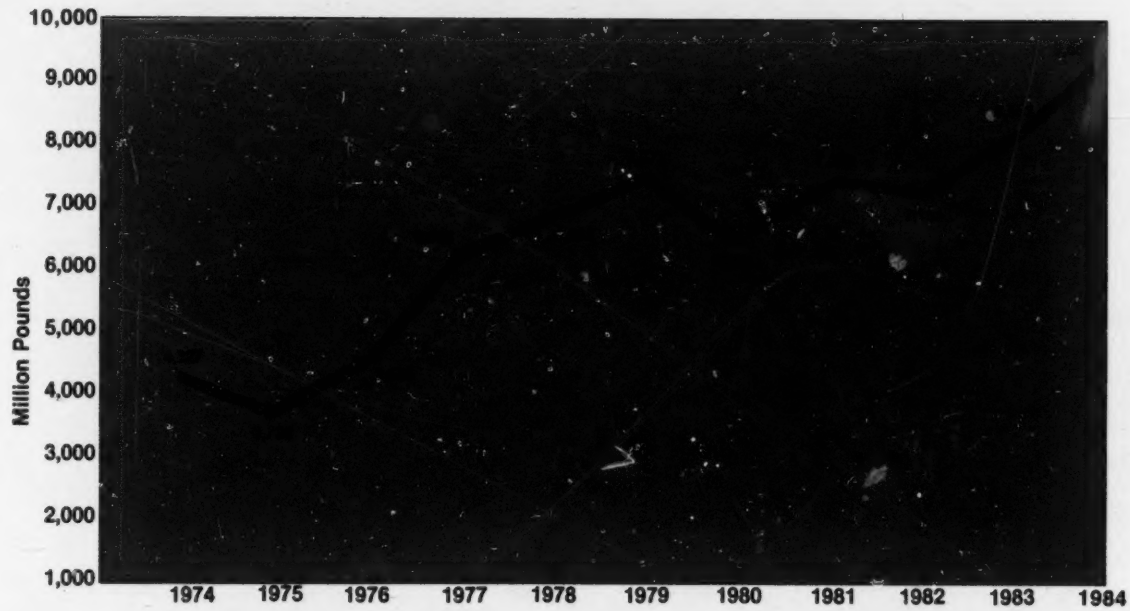
TOTAL THERMOSETS
0.4%
51 MILLION POUNDS

TOTAL THERMOPLASTICS
99.6%
12,347 MILLION POUNDS

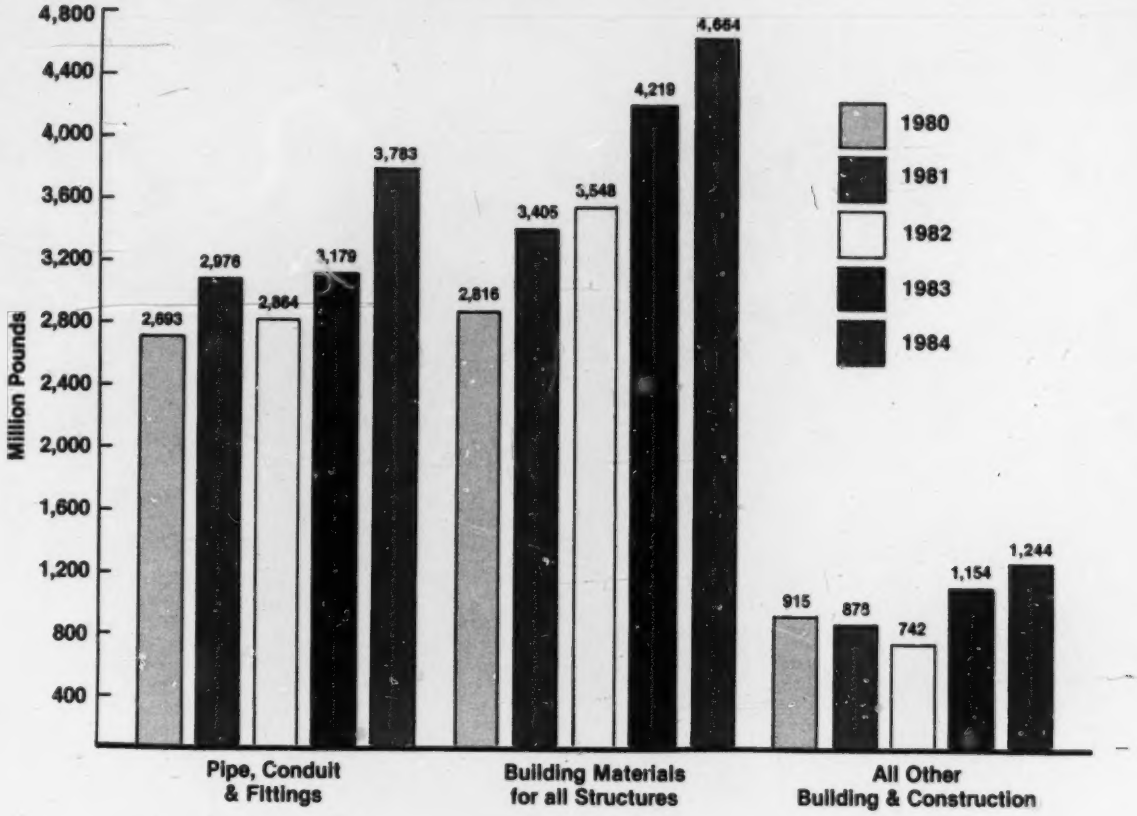
PACKAGING — THERMOPLASTIC DISTRIBUTION

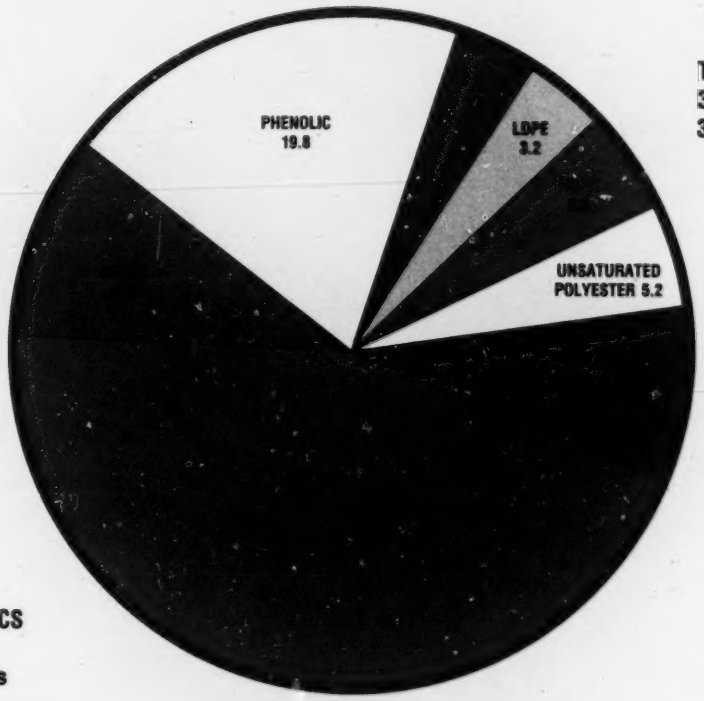


BUILDING AND CONSTRUCTION



BUILDING AND CONSTRUCTION (cont'd.)

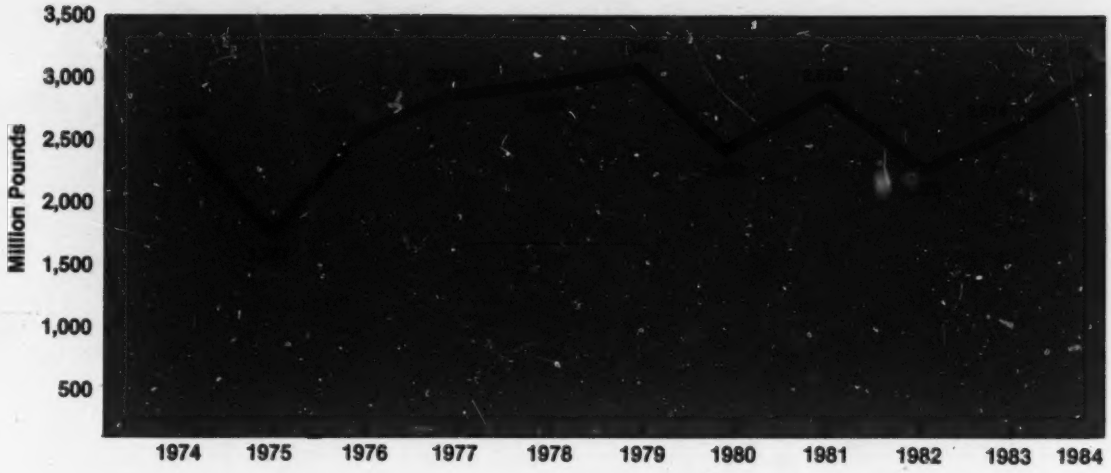


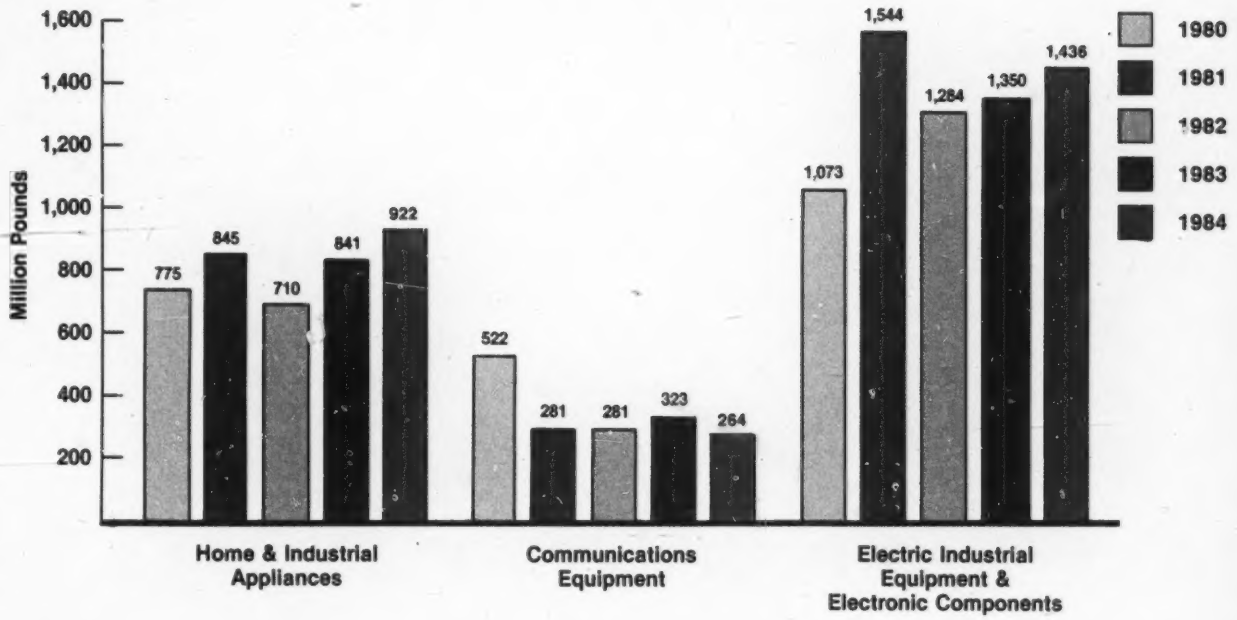


TOTAL THERMOSETS
34.6%
3,355 Million Pounds

TOTAL THERMOPLASTICS
65.4%
6,336 Million Pounds

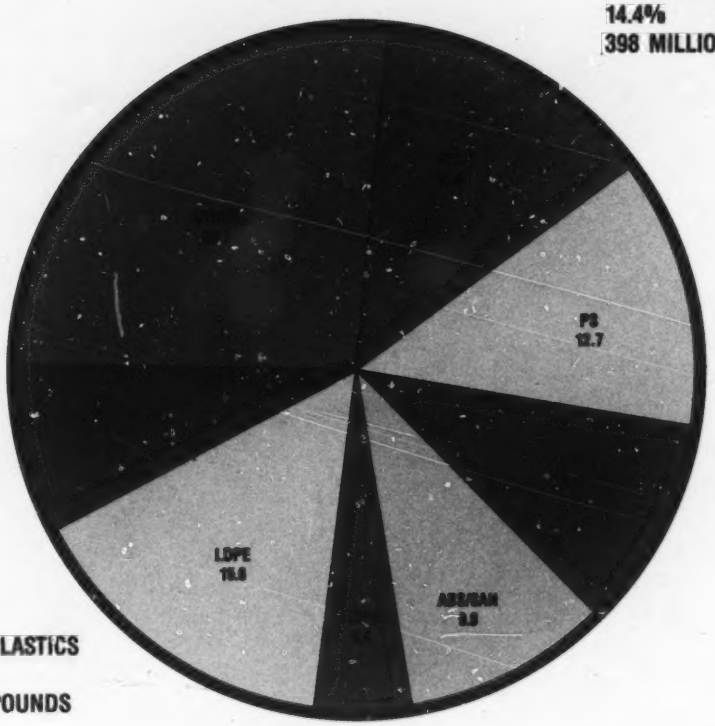
ELECTRICAL AND ELECTRONIC





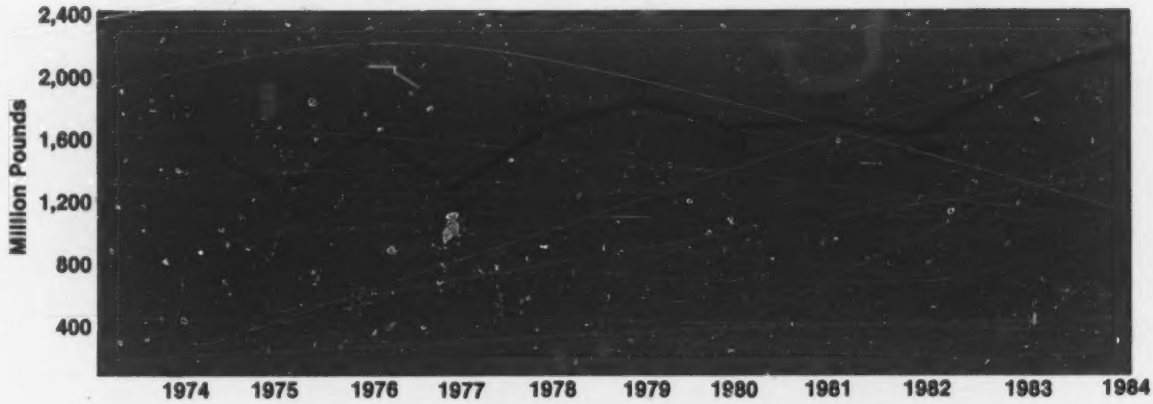
ELECTRICAL AND ELECTRONIC (cont'd.)

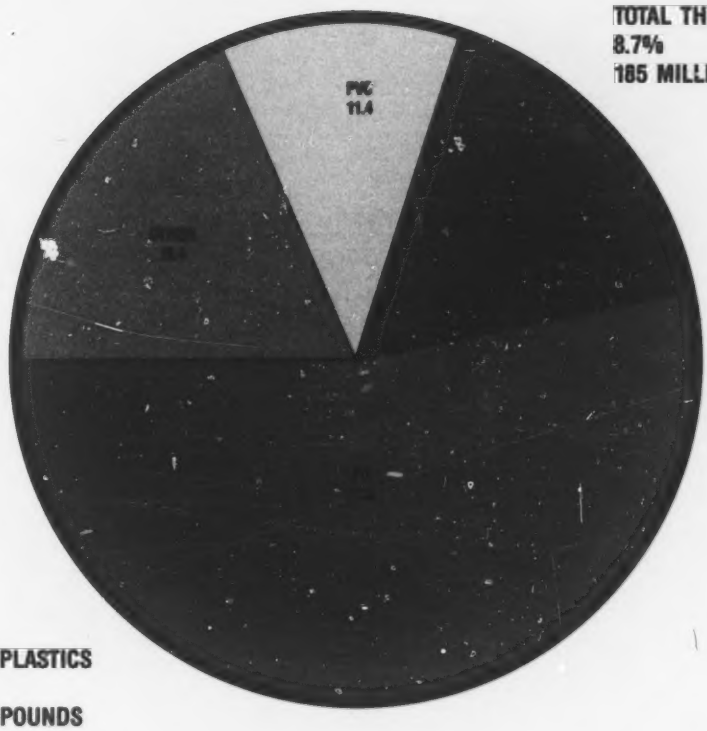
TOTAL THERMOSETS
14.4%
398 MILLION POUNDS



TOTAL THERMOPLASTICS
85.6%
2,359 MILLION POUNDS

FURNITURE AND FURNISHINGS

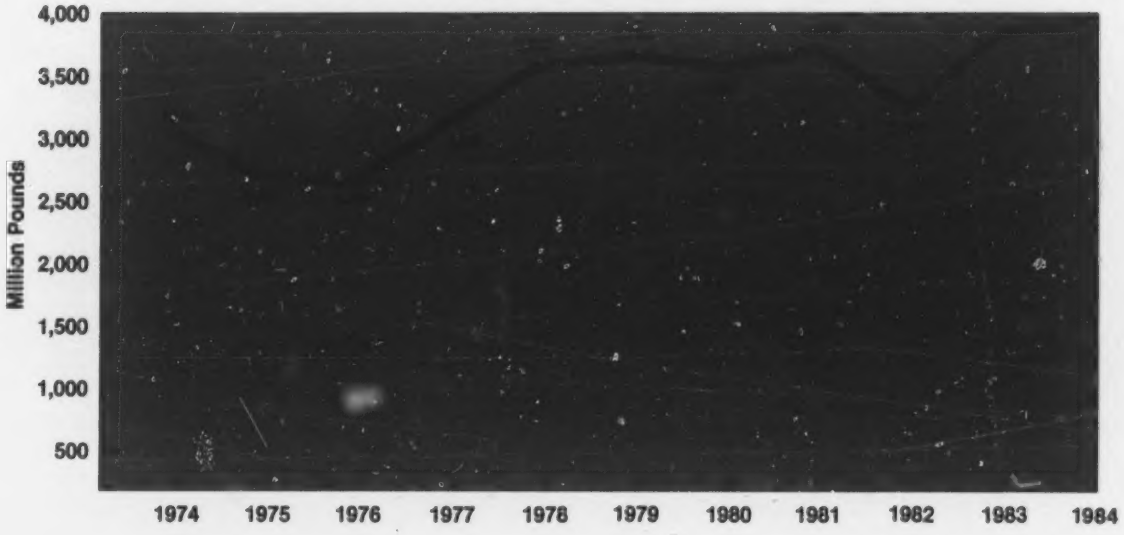


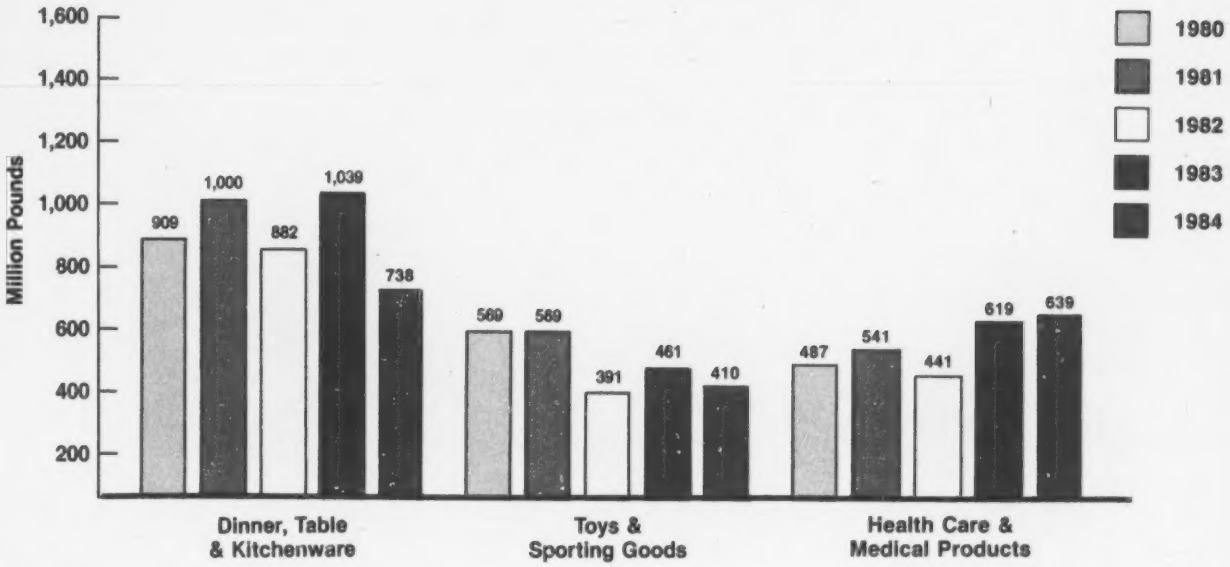


TOTAL THERMOSETS
8.7%
185 MILLION POUNDS

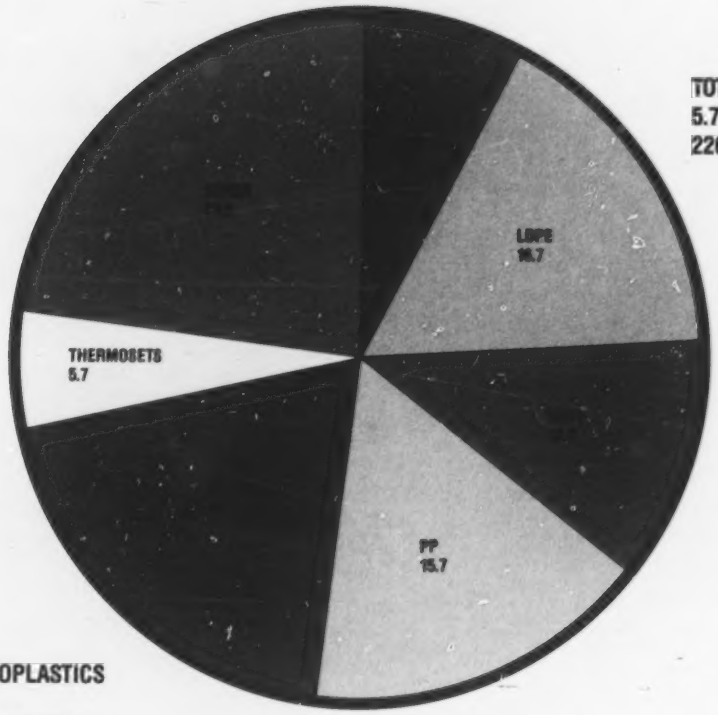
TOTAL THERMOPLASTICS
91.3%
1,932 MILLION POUNDS

CONSUMER AND INSTITUTIONAL





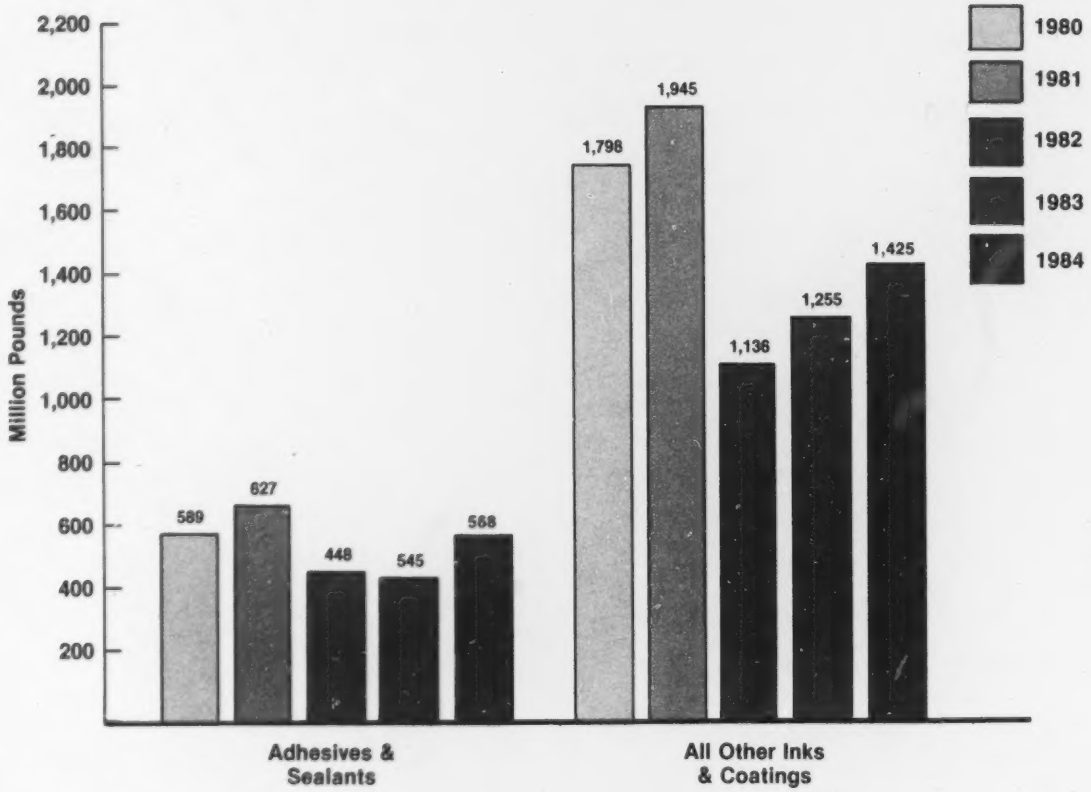
CONSUMER AND INSTITUTIONAL (cont'd.)



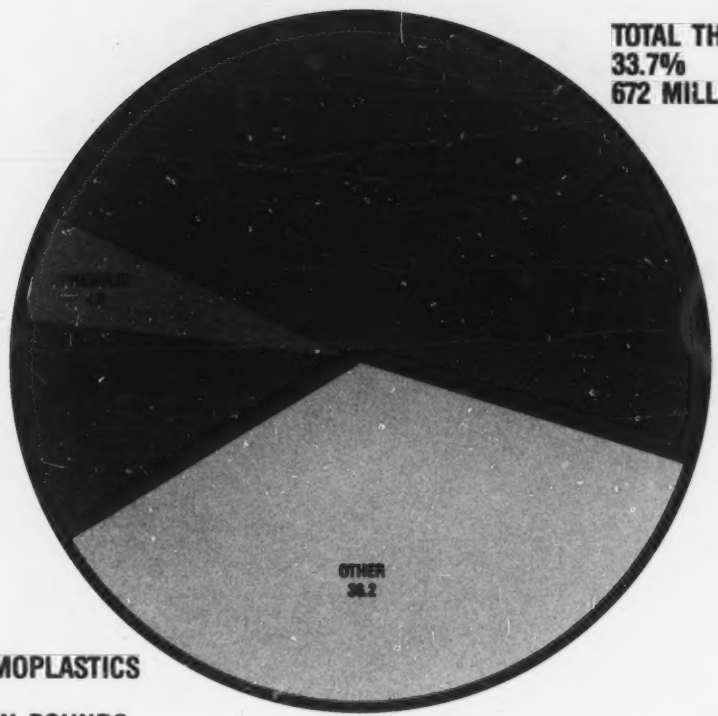
TOTAL THERMOSETS
5.7%
226 MILLION POUNDS

TOTAL THERMOPLASTICS
94.3%
3,760 MILLION POUNDS

ADHESIVES/INKS/COATINGS



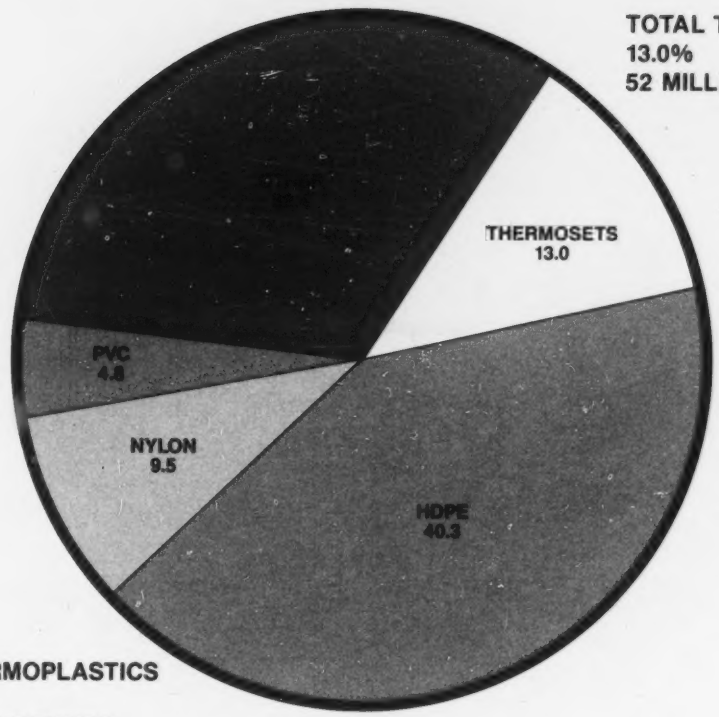
ADHESIVES/INKS/COATINGS (cont'd.)



TOTAL THERMOSETS
33.7%
672 MILLION POUNDS

TOTAL THERMOPLASTICS
66.3%
1,321 MILLION POUNDS

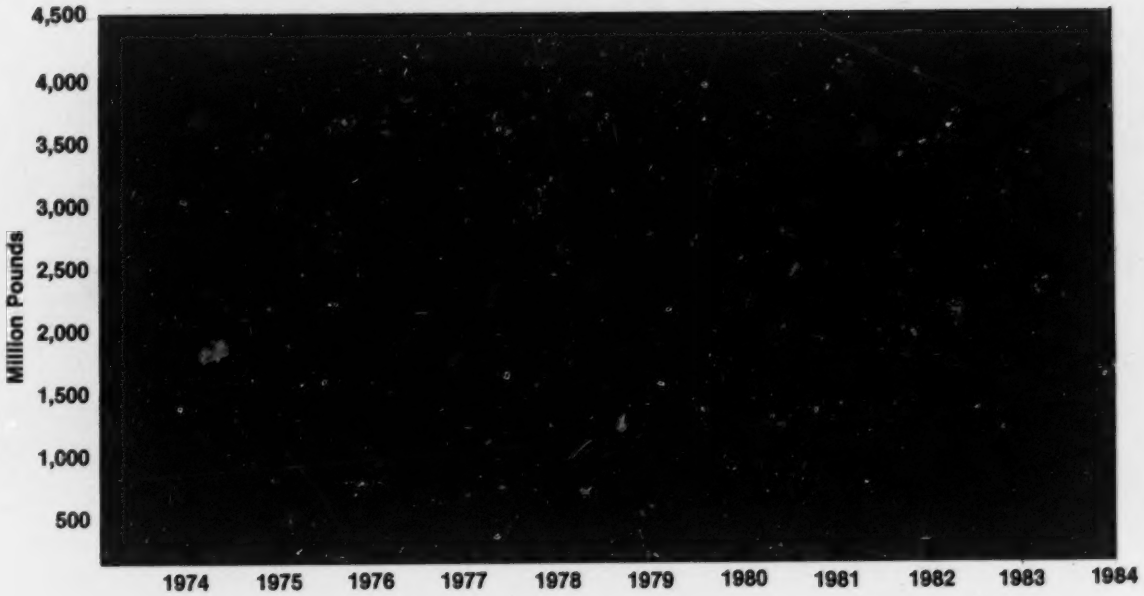
INDUSTRIAL/MACHINERY

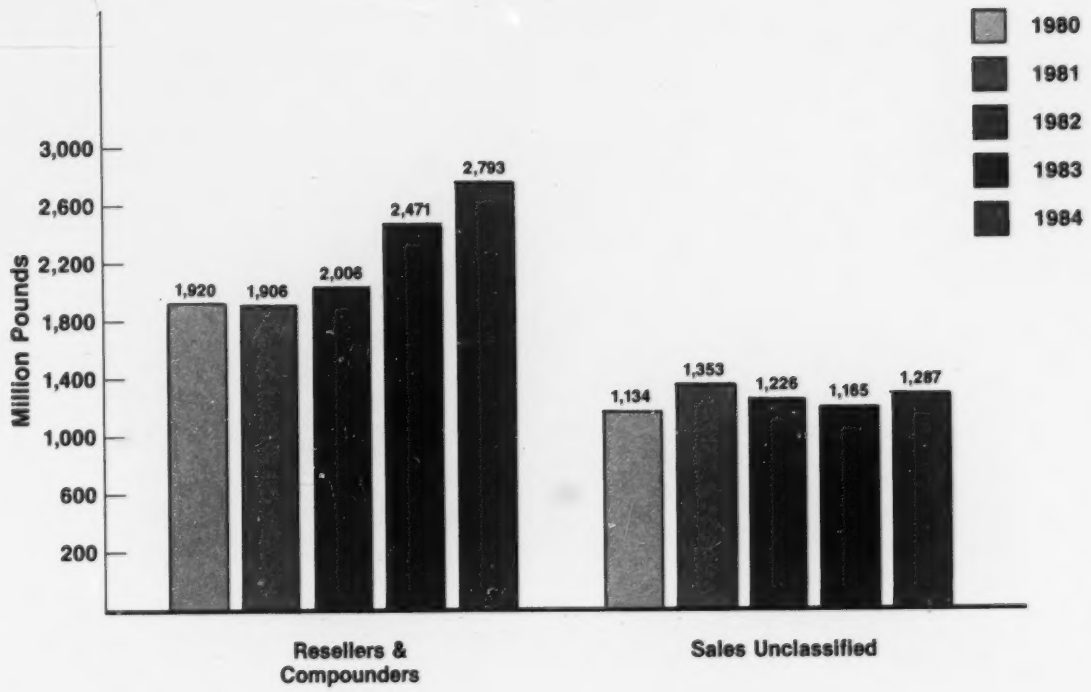


TOTAL THERMOSETS
13.0%
52 MILLION POUNDS

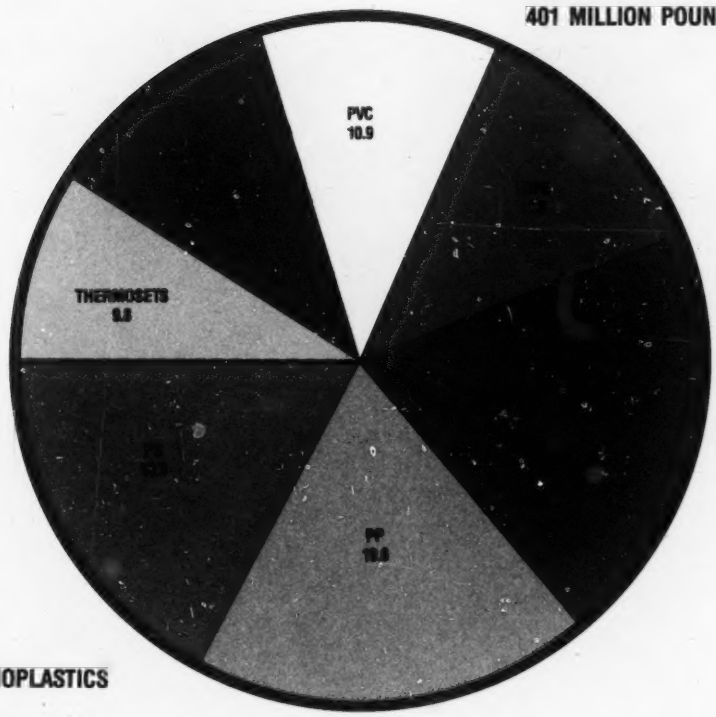
TOTAL THERMOPLASTICS
87.0%
348 MILLION POUNDS

ALL OTHER


4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
Million Pounds
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984


1980
1981
1982
1983
1984
3,000
2,600
2,200
1,800
1,400
1,000
600
200
Million Pounds
1,920
1,906
2,006
2,471
2,793
1,134
1,353
1,226
1,165
1,287
Resellers & Compounders
Sales Unclassified

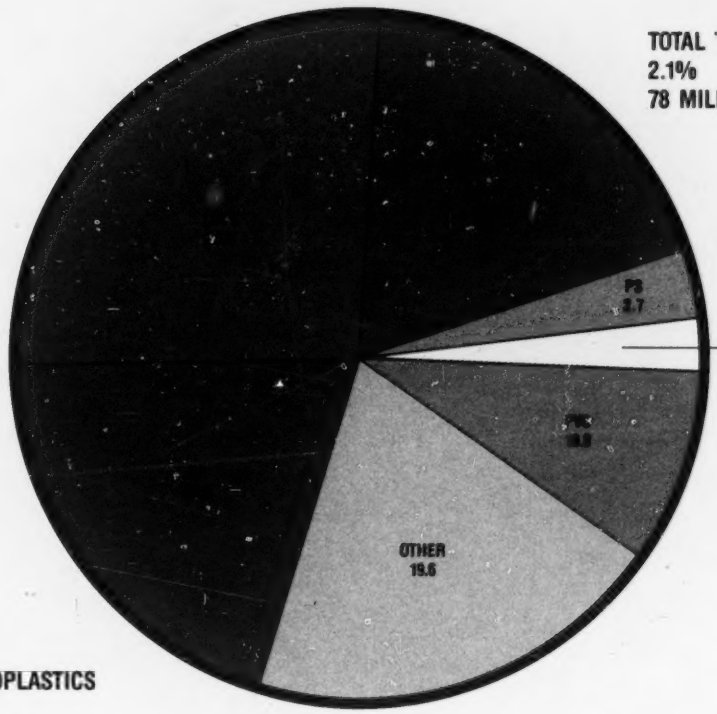
ALL OTHER (cont'd.)



TOTAL THERMOSETS
9.8%
401 MILLION POUNDS

TOTAL THERMOPLASTICS
90.2%
3,679 MILLION POUNDS

EXPORTS



TOTAL THERMOSETS
2.1%
78 MILLION POUNDS

TOTAL THERMOPLASTICS
97.9%
3,718 MILLION POUNDS

APPENDIX A

Table of 1984 distribution of plastics resins sales and use by Major Market, including market segments.

THE SOCIETY OF THE PLASTIC INDUSTRY, INC.

1984 DISTRIBUTION OF PLASTIC RESINS SALES & USE *(CAPTIVE)* BY MAJOR MARKET

(In millions of pounds, dry weight basis) (1)

MAJOR MARKET	TOTAL THERMOSETS		TOTAL THERMOPLASTICS		GRAND TOTAL	
	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL
TRANSPORTATION, TOTAL	558	9.3	1,551	4.2	2,109	4.9
Motor Vehicles and Parts	262	4.4	1,466	3.9	1,728	4.0
Ships, Boats and Recreational Vehicles	264	4.4	25	0.1	289	0.7
All Other Transportation Equipment	32	0.5	60	0.2	92	0.2
PACKAGING, TOTAL	51	0.9	12,347	33.1	12,398	28.6
Bottles, Jars, Vials			2,128	5.7		
Food Containers Including Disposable Cups			2,114	5.7		
Flexible Packaging - *(Bags, Liners, Etc.)*						
Household and Institutional Refuse Bags & Film			5,665	15.2		
All Other Flexible Packaging	-	-	2,397	6.4	2,397	5.5
All Other Packaging			3,268	8.8		
	38	0.6	2,440	6.5	2,478	5.7
BUILDING AND CONSTRUCTION, TOTAL	3,355	56.1	6,336	17.0	9,691	22.4
Pipe, Conduit and Fittings	86	1.4	3,697	9.9	3,783	8.7
Building Materials for All Structures	2,646	44.3	2,018	5.4	4,664	10.8
Siding	796	13.3	390	1.0	1,186	2.7
Flooring	815	13.7	523	1.4	1,338	3.1
Insulation Material	495	8.3	336	0.9	831	1.9
All Other Building Materials for All Structures	540	9.0	769	2.1	1,309	3.1
All Other Building and Construction	625	10.4	621	1.7	1,244	2.9
ELECTRICAL/ELECTRONIC, TOTAL	398	6.7	2,359	6.3	2,757	6.3
Home and Industrial Appliances	104	1.7	818	2.2	922	2.1
Communications Equipment	16	0.3	248	0.6	264	0.6
Electric Industrial Equipment Combined with Electronic Components	278	4.7	1,158	3.1	1,436	3.3
Storage Batteries	-	-	135	0.4	135	0.3
FURNITURE AND FURNISHINGS, TOTAL	185	3.1	1,932	5.2	2,117	4.9
Rigid Furniture	179	3.0	141	0.4	320	0.7
Flexible Furniture			38	0.1		
Carpet and Carpet Components	-	-	953	2.6	953	2.2
Other Textiles and Furnishings			800	2.1		
CONSUMER AND INSTITUTIONAL PRODUCTS, TOTAL	226	3.8	3,760	10.1	3,986	9.2
Disposables	103	1.7	635	1.7	738	1.7
Health Care and Medical Products	-	-	639	1.7	639	1.5
Toys and Sporting Goods	17	0.3	393	1.1	410	0.9
Hobby and Graphic Arts Supplies	8	0.2	405	1.1	413	1.0
All Other Consumer and Institutional Products	98	1.6	1,688	4.5	1,786	4.1
INDUSTRIAL/MACHINERY, TOTAL	52	0.9	348	0.9	400	0.9
ADHESIVES/INKS/COATINGS, TOTAL	672	11.2	1,321	3.5	1,993	4.6
Adhesives and Sealants	79	1.3	489	1.3	568	1.3
All Other Inks and Coatings	593	9.9	832	2.2	1,425	3.3
ALL OTHER (RESELLERS, COMPOUNDERS), TOTAL	401	6.7	3,679	9.8	4,080	9.4
Resellers and Compounders	144	2.4	2,649	7.1	2,793	6.5
Sales Unclassified	257	4.3	1,030	2.7	1,287	2.9
EXPORTS, TOTAL	78	1.3	3,718	9.9	3,796	8.8
GRAND TOTAL	5,976	100.0	37,351	100.0	43,327	100.0

Release date: May 20, 1985

Page 1 (1)- Except phenolic resins which are on a gross weight basis.

SOURCE: SPI COMMITTEE ON RESIN STATISTICS AS COMPILED BY ERNST & WHINNEY

THE SOCIETY OF THE PLASTIC INDUSTRY, INC.

1984 DISTRIBUTION OF PLASTIC RESINS SALES & USE *(CAPTIVE)* BY MAJOR MARKET

(In millions of pounds, dry weight basis) (1)

MAJOR MARKET	EPOXY		POLYESTER		UREA & MELAMINE		PHENOLICS		ALL OTHER THERMOSETS	
	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL
TRANSPORTATION, TOTAL	D	D	388	31.5	D	D	150	6.0	D	D
Motor Vehicles and Parts			135	11.0						
Ships, Boats and Recreational Vehicles			243	19.7						
All Other Transportation Equipment			10	0.8						
PACKAGING, TOTAL	D	D	-	-	32	2.3	D	D	-	-
Bottles, Jars, Vials										
Food Containers Including Disposable Cups										
Flexible Packaging - *(Bags, Liners, Etc.)*										
Household and Institutional Refuse Bags & Film					-	-				
All Other Flexible Packaging										
All Other Packaging										
BUILDING AND CONSTRUCTION, TOTAL	36	9.5	502	40.8	896	64.6	1,921	76.5	-	-
Pipe, Conduit and Fittings			53	4.3			10	0.4		
Building Materials for All Structures	14	3.7	176	14.3						
Siding			63	5.1	-	-	731	29.1		
Flooring							320	12.7		
Insulation Material	-	-					491	19.6		
All Other Building Materials for All Structures			110	8.9						
All Other Building and Construction			273	22.2						
ELECTRICAL/ELECTRONIC, TOTAL	82	21.6	66	5.4	D	D	162	6.4	D	D
Home and Industrial Appliances							93	3.7		
Communications Equipment							11	0.4		
Electric Industrial Equipment Combined with Electronic Components			54	4.4			58	2.3		
Storage Batteries	-	-	-	-			-	-		
FURNITURE AND FURNISHINGS, TOTAL	D	D	11	0.9	D	D	D	D	-	-
Rigid Furniture										
Flexible Furniture										
Carpet and Carpet Components			-	-						
Other Textiles and Furnishings										
CONSUMER AND INSTITUTIONAL PRODUCTS, TOTAL	D	D	72	5.8	D	D	D	D	D	D
Disposables			-	-						
Health Care and Medical Products			-	-						
Toys and Sporting Goods			14	1.1						
Hobby and Graphic Arts Supplies			8	0.6						
All Other Consumer and Institutional Products			50	4.1						
INDUSTRIAL/MACHINERY, TOTAL	D	D	D	D	-	-	9	0.4	-	-
ADHESIVES/INKS/COATINGS, TOTAL	122	32.2	D	D	D	D	80	3.2	400	85.1
Adhesives and Sealants	24	6.3							-	-
All Other Inks and Coatings	98	25.9							400	85.1
ALL OTHER (RESELLERS, COMPOUNDERS), TOTAL	D	D	129	10.5	118	8.5	96	3.8	D	D
Resellers and Compounders			50	4.1	50	3.6				
Sales Unclassified			79	6.4	68 #	4.9 #				
EXPORTS, TOTAL	41	10.8	8	0.6	D #	D #	22	0.9	7	1.5
GRAND TOTAL	379	100.0	1,231	100.0	1,386	100.0	2,510	100.0	470	100.0

(1)-Except phenolic resins which are on a gross weight basis

Page 2 Note: Table does not add vertically or horizontally due to disclosure. D = Disclosure

SOURCE: SPI COMMITTEE ON RESIN STATISTICS AS COMPILED BY ERNST & WHINNEY

Urea And melamine exports included in sales unclassified

THE SOCIETY OF THE PLASTIC INDUSTRY, INC.

1984 DISTRIBUTION OF PLASTIC RESINS SALES & USE *(CAPTIVE)* BY MAJOR MARKET

(In millions of pounds, dry weight basis)

MAJOR MARKET	LOW DENSITY PE		HIGH DENSITY PE		POLYPROPYLENE		ABS & SAN		POLYSTYRENE		SBL,OSBL, & OSBP	
	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL
TRANSPORTATION, TOTAL	D	D	D	D	233	4.8	267	22.5	D	D	D	D
Motor Vehicles and Parts					220	4.6	259	21.8				
Ships, Boats and Recreational Vehicles												
All Other Transportation Equipment												
PACKAGING, TOTAL	5,393	64.1	2,954	49.7	901	18.7	13	1.1	1,540	40.1	D	D
Bottles, Jars, Vials	22	0.3	1,158	19.5	129	2.7			80	2.1		
Food Containers Including Disposable Cups	342	4.1	632	10.6	39	0.8			1,004	26.2		
Flexible Packaging - *(Bags, Liners, Etc.)*	4,361	51.8	326	5.5	368	7.6	-	-				
Household and Institutional Refuse Bags & Film	1,933	23.0	64	1.1	230	4.8	-	-	-	-		
All Other Flexible Packaging	2,428	28.8	262	4.4	138	2.8	-	-				
All Other Packaging	668	7.9	838	14.1	366	7.6						
BUILDING AND CONSTRUCTION, TOTAL	313	3.7	513	8.6	36	0.7	D	D	385	10.0	D	D
Pipe, Conduit and Fittings	37	0.4	494	8.3	4	0.1						
Building Materials for All Structures	97	1.2							351	9.1		
Siding	-	-			-	-			-	-		
Flooring	-	-	-	-	-	-			-	-		
Insulation Material					-	-			316	8.2		
All Other Building Materials for All Structures									35	0.9		
All Other Building and Construction	179	2.1										
ELECTRICAL/ELECTRONIC, TOTAL	430	5.1	149	2.5	289	6.0	269	22.7	351	9.2	D	D
Home and Industrial Appliances					125	2.6			269	7.0		
Communications Equipment												
Electric Industrial Equipment Combined with Electronic Components	397	4.7	114**	1.9**								
Storage Batteries	-	-			116	2.4			-	-		
FURNITURE AND FURNISHINGS, TOTAL	4	0.1	D	D	1,123	23.3	D	D	26	0.6	342	34.8
Rigid Furniture									13	0.3	-	-
Flexible Furniture									-	-	-	-
Carpet and Carpet Components					601	12.5			-	-	307	31.2
Other Textiles and Furnishings					493	10.2			13	0.3	35	3.6
CONSUMER AND INSTITUTIONAL PRODUCTS, TOTAL	666	7.9	488	8.2	624	12.9	D	D	754	19.6	D	D
Disposables	204	2.4	90	1.5	91	1.9			235	6.1		
Health Care and Medical Products	119	1.4			237	4.9			75	2.0		
Toys and Sporting Goods			70	1.2	34	0.7			178	4.6		
Hobby and Graphic Arts Supplies					24	0.5			40	1.0		
All Other Consumer and Institutional Products	256	3.0	292	4.9	238	4.9			226	5.9		
INDUSTRIAL/MACHINERY, TOTAL	D	D	161	2.7	D	D	D	D	D	D	D	D
ADHESIVES/INKS/COATINGS, TOTAL	67	0.8	D	D	D	D	-	-	-	-	311	31.6
Adhesives and Sealants											19	1.9
All Other Inks and Coatings											292	29.7
ALL OTHER (RESELLERS, COMPOUNDERS), TOTAL	541	6.4	783	13.2	800	16.6	174	14.7	664	17.3	52	5.3
Resellers and Compounders	422	5.0	554	9.3	651	13.5			460	12.0		
Sales Unclassified	119	1.4	229	3.9	149	3.1			204	5.3		
EXPORTS, TOTAL	974	11.6	696	11.7	782	16.2	D	D	101	2.6	D	D
GRAND TOTAL	8,416	100.0	5,949	100.0	4,816	100.0	1,187	100.0	3,836	100.0	982	100.0

Note: Table does not add horizontally or vertically due to disclosure.

SOURCE: SPI COMMITTEE ON RESIN STATISTICS AS COMPILED BY ERNST & WHINNEY D-Disclosure **Includes storage batteries.

THE SOCIETY OF THE PLASTIC INDUSTRY, INC.

1984 DISTRIBUTION OF PLASTIC RESINS SALES & USE *(CAPTIVE)* BY MAJOR MARKET

(In millions of pounds, dry weight basis)

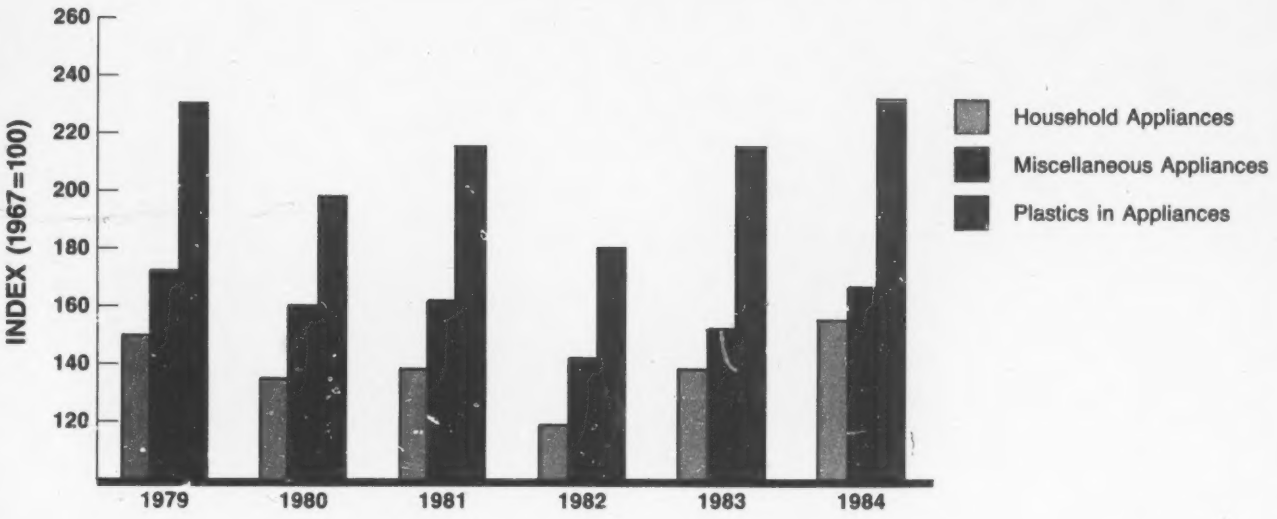
MAJOR MARKET	NYLON		PVC		PVAc, PVOH, OTHER VINYLS		THERMOPLASTIC POLYESTER		ALL OTHER THERMOPLASTIC			
	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL	QUANTITY	% OF TOTAL
TRANSPORTATION, TOTAL	156	40.1	163	2.4	D	D	51	5.9	439	14.1		
Motor Vehicles and Parts			141	2.1					435	14.0		
Ships, Boats and Recreational Vehicles							-	-				
All Other Transportation Equipment												
PACKAGING, TOTAL	38	9.8	619	9.1	D	D	609	70.9	125	4.0		
Bottles, Jars, Vials			162	2.4					12	0.4		
Food Containers Including Disposable Cups							-	-	20	0.6		
Flexible Packaging - *(Bags, Liners, Etc.)*			285	4.2								
Household and Institutional Refuse Bags & Film			142	2.1					71	2.3		
All Other Flexible Packaging			143	2.1					-	-		
All Other Packaging									71	2.3		
BUILDING AND CONSTRUCTION, TOTAL	D	D	4,134	60.8	21	2.1	D	D	732	23.6		
Pipe, Conduit and Fittings			2,998	44.1	-	-						
Building Materials for All Structures			835	12.3					663	21.4		
Siding			383	5.6	-	-						
Flooring			323	4.8	-	-						
Insulation Material					-	-						
All Other Building Materials for All Structures			301	4.4								
All Other Building and Construction												
ELECTRICAL/ELECTRONIC, TOTAL	73	18.8	398	5.9	D	D	D	D	340	11.0		
Home and Industrial Appliances			53	0.8					105	3.4		
Communications Equipment			87	1.3								
Electric Industrial Equipment Combined with Electronic Components	53**	13.6**	258**	3.8**								
Storage Batteries												
FURNITURE AND FURNISHINGS, TOTAL	6	1.5	242	3.5	57	5.6	D	D	58	1.9		
Rigid Furniture			6	0.1					57	1.8		
Flexible Furniture			34	0.5	-	-			-	-		
Carpet and Carpet Components	-	-	40	0.6					-	-		
Other Textiles and Furnishings			162	2.3					1	0.1		
CONSUMER AND INSTITUTIONAL PRODUCTS, TOTAL	D	D	290	4.3	63	6.2	16	1.9	627	20.2		
Disposables					-	-			1	0.1		
Health Care and Medical Products			75	1.1					38	1.2		
Toys and Sporting Goods			11	0.2	-	-			6	0.2		
Hobby and Graphic Arts Supplies			9	0.1					274	8.8		
All Other Consumer and Institutional Products									308	9.9		
INDUSTRIAL/MACHINERY, TOTAL	38	9.8	19	0.3	-	-	3	0.3	41	1.3		
ADHESIVES/INKS/COATINGS, TOTAL	D	D	108	1.6	652	64.2	D	D	175	5.7		
Adhesives and Sealants			24	0.4	303	29.8			88	2.9		
All Other Inks and Coatings			84	1.2	349	34.4			87	2.8		
ALL OTHER (RESELLERS, COMPOUNDERS), TOTAL	20	5.1	446	6.5	14	1.4	17	2.0	168	5.4		
Resellers and Compounders	19	4.9	260	3.8					127	4.1		
Sales Unclassified	1	0.2	186	2.7					41	1.3		
EXPORTS, TOTAL	26	6.7	379	5.6	84	8.3	99	11.5	397	12.8		
GRAND TOTAL	389	100.0	6,798	100.0	1,016	100.0	860	100.0	3,102	100.0		

Note: This table does not add horizontally or vertically due to disclosure.

SOURCE: SPI COMMITTEE ON RESIN STATISTICS AS COMPILED BY ERNST & WHINNEY

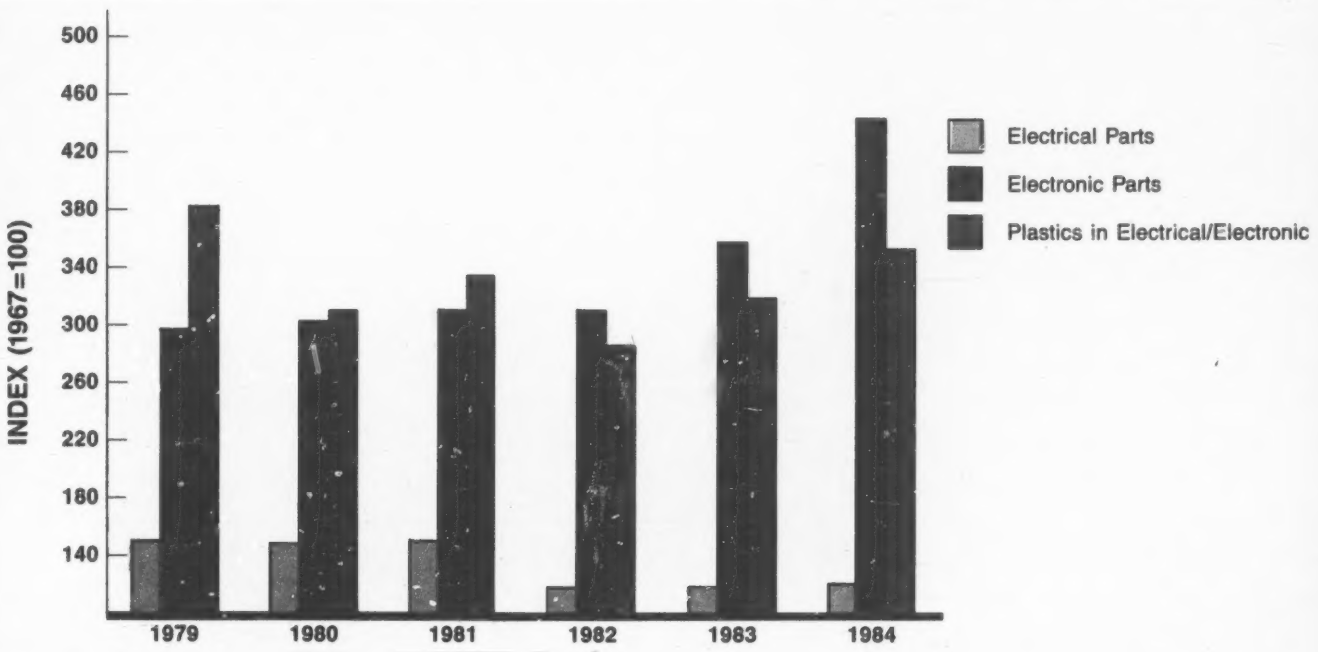
D-Disclosure ** Includes Storage Batteries.

PLASTICS IN APPLIANCES vs TOTAL APPLIANCES[1]



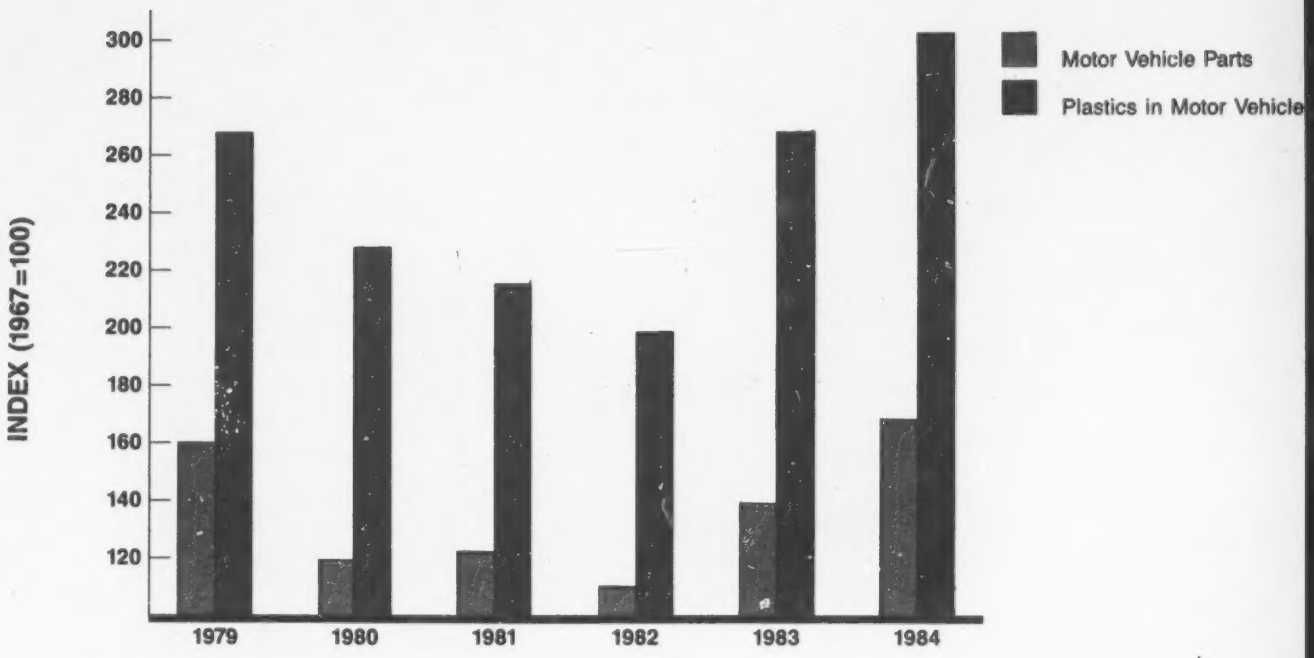
[1]Plastics Sales vs Appliance Industrial Production
Source: SPI
Modern Plastics Magazine
Survey of Current Business

PLASTICS IN ELECTRICAL/ELECTRONIC vs TOTAL ELECTRICAL/ELECTRONIC[1]



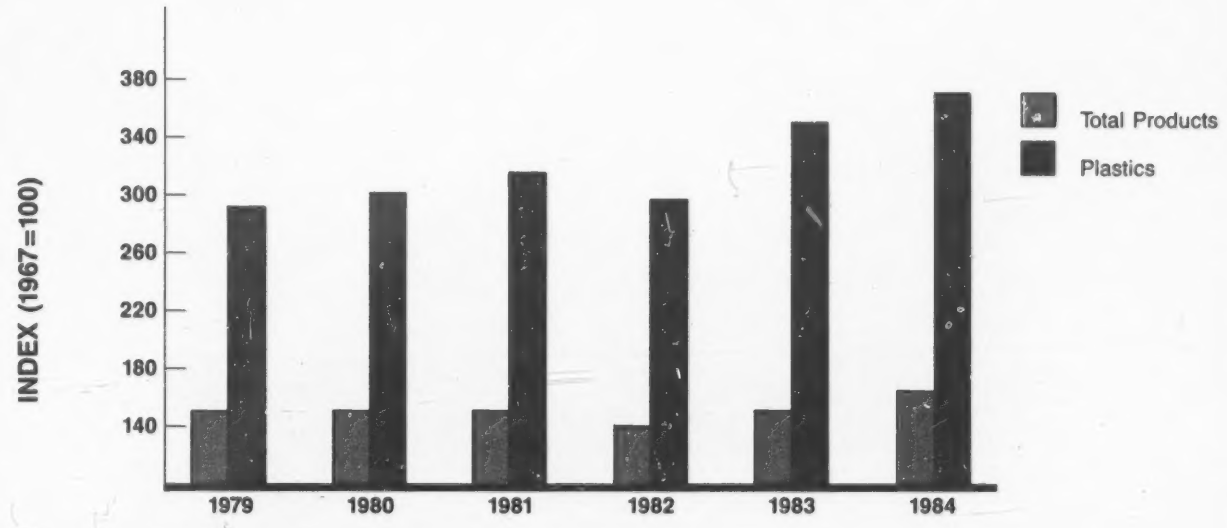
[1]Plastics Sales vs Electrical/Electronic Industrial Production
Source: SPI
Modern Plastics Magazine
Survey of Current Business

PLASTICS IN MOTOR VEHICLES vs TOTAL MOTOR VEHICLE PARTS[1]



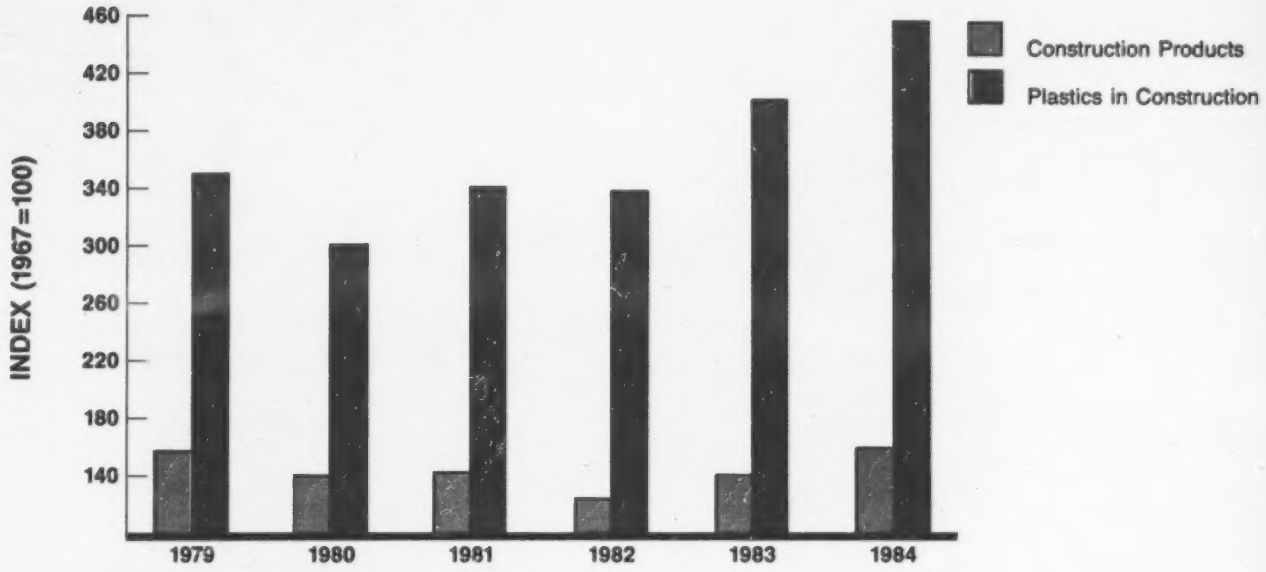
[1]Plastics Sales vs Motor Vehicle Parts Industrial Production
Source: SPI
Modern Plastics Magazine
Survey of Current Business

PLASTICS CONSUMPTION vs TOTAL PRODUCTS[1]



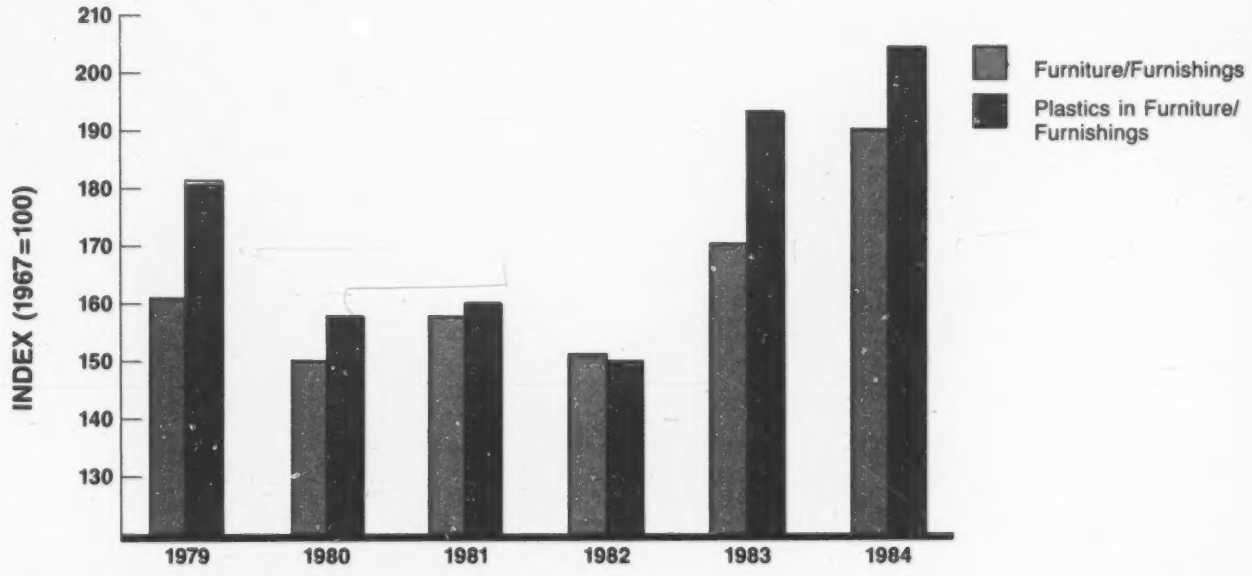
[1]Plastics Sales vs Total Products Industrial Production
Source: SPI
Modern Plastics Magazine
Survey of Current Business

PLASTICS IN CONSTRUCTION vs TOTAL CONSTRUCTION PRODUCTS[1]



[1]Plastics Sales vs Construction Industrial Production
Source: SPI
Modern Plastics Magazine
Survey of Current Business

PLASTICS IN FURNITURE/FURNISHINGS vs TOTAL FURNITURE/FURNISHINGS[1]



[1]Plastics Sales vs Furniture Industrial Production
Source: SPI
Modern Plastics Magazine
Survey of Current Business

PROCESSING & MACHINERY

PROCESSING METHODS

INJECTION MOLDING

Injection molding is the principal method of forming thermoplastic materials. Modifications of the injection process are sometimes used for thermosetting plastics.

In injection molding, plastic material is put into a hopper which feeds into a heating chamber. A plunger pushes the plastic through this long heating chamber where the material is softened to a fluid state. At the end of this chamber there is a nozzle which abuts firmly against an opening into a cool, closed mold. The fluid plastic is forced at high pressure through this nozzle into the cold mold. As soon as the plastic cools to a solid state, the mold opens and the finished plastic is ejected from the press.

THe problem with injection molding of thermosetting materials is that, under heat, these plastics will first soften, then harden to an infusible state. Thus it is essential that no softened thermosetting material in the heating chamber be allowed to remain there long enough to set.

Jet molding, offset molding and molding using a screw-type machine overcome this problem by liquefying the thermosetting plastic material just as it goes through the injection nozzle into the mold, but not before.

BLOW MOLDING

Blow molding is a method of forming used with thermoplastic materials.

Basically, blow molding consists of stretching and then hardening a plastic against a mold. There are two general methods of doing this type of thermoplastic molding: the direct method and the indirect method, encompassing several variations of each.

In the direct method, a glob of molten thermoplastic material is formed into the rough shape of the desired finished product. This shape is then inserted in a female mold and air blown into the plastic, as into a balloon, to force it against the sides of the mold. The formed material is then cooled before removal from the mold.

In the indirect method, a thermoplastic sheet or special shape is first heated, then clamped between a die and cover. Air pressure forced between the plastic and the cover forces the material into contact with the die, which has the contour desired in the finished product. The plastic is cooled before removal from contact with the die.

COMPRESSION MOLDING

Compression molding is the most common method of forming thermosetting materials. It is not generally used for thermoplastics.

Compression molding is simply the squeezing of a material into a desired shape by application of heat and pressure to the material in a mold.

Plastic molding powder, mixed with such materials or fillers as woodflour, cellulose and asbestos to strengthen or give other added qualities to the finished product, is put directly into the open mold cavity. The mold is then closed, pressing down on the plaastic and causing it to flow throughout the mold. It is while the heated mold is closed that the thermosetting material undergoes a chemical change which permanently hardens it into the shape of the mold. The three compression molding factors—pressure, temperature and time mold is closed—vary with the design of the finished article and the material being molded.

EXTRUSION

Extrusion molding is the method employed to form thermoplastic materials into continuous sheeting, film, tubes, rods, profile shapes, filaments, and to coat wire, cable and cord.

In extrusion, dry plastic material is first loaded into a hopper, then fed into a long heating chamber through which it is moved by the action of a continuously revolving screw. At the end of the heating chamber the molten plastic is forced out through a small opening or die with the shape desired in the finished product. As the plastic extrusion comes from the die, it is fed onto a conveyor belt where it is cooled, most frequently by blowers or by immersion in water.

In the case of wire and cable coating, the thermoplastic is extruded around a continuing length of wire or cable which, like the plastic, passes through the extruder die. The coated wire is wound on drums after cooling.

In producing wide film or sheeting, the plastic is extruded in the form of a tube. This tube may be split as it comes from the die and then stretched and thinned to the dimensions desired in the finished film.

In a different process, the extruded tubing is inflated as it comes from the die, the degree of inflation of the tubing regulating the thickness of the final film.

THERMOFORMING

Thermoforming of plastic sheet has developed rapidly in recent years. Basically, this process consists of heating thermoplastic sheet to a formable plastic state and then applying air and/or mechanical assists to shape it to the contours of a mold.

Air pressure may range from almost zero to several hundred psi. Up to approximately 14 psi (atmospheric pressure), the pressure is obtained by evacuating the space between the sheet and the mold in order to utilize this atmospheric pressure. This range, known as *vacuum forming*, will give satisfactory reproduction of the mold configuration in the majority of forming applications.

TRANSFER MOLDING

Transfer molding is most generally used for thermosetting plastics.

This method is like compression molding in that the plastic is cured into an infusible state in a mold under heat and pressure. It differs from compression molding in that the plastic is heated to a point of plasticity before it reaches the mold and is forced into a closed mold by means of an hydraulically-operated plunger.

Transfer molding was developed to facilitate the molding of intricate products with small deep holes or numerous metal inserts. The dry molding compound used in compression molding sometimes disturbs the position of the metal inserts and the pins which form the holes. The liquefied plastic material in transfer molding flows around these metal parts without causing them to shift position.

REACTION INJECTION MOLDING

Reaction injection molding (RIM) is a relatively new processing technique that has rapidly taken its place alongside more traditional methods. Unlike liquid casting, the two liquid components, polyols and isocyanates, are mixed in a chamber at relatively low temperatures (75°-140°) before injection into a closed mold. An exothermic reaction occurs and consequently RIM requires far less energy usage than any other injection molding system.

The three major types of polyurethane RIM systems are rigid structural foam, low-modulus elastomers, and high-modulus elastomers.

Reinforced RIM (R-RIM) consists in the addition of such materials as chopped or milled glass fiber to the polyurethane to enhance stiffness and to increase modulus thus expanding the range of applications.

DOLLAR SALES OF PLASTICS MACHINERY

(in millions of dollars)

MACHINE TYPE	1980	1981	1982	1983[a]	1984
Injection Molding	296.7	311.2	225.0	298.0	338.0
Structural Foam	11.7	8.7	5.0	4.5	4.5
Extrusion, single screw	203.5	201.0	140.0	85.0	95.0
Extrusion, multi screw	25.9	23.3	19.0	18.5	17.5
Blow Molding	100.0	100.0	89.0	120.0	65.0
Thermoforming	26.2	32.0	28.0	33.0	39.0
Reaction-Injection Molding	6.7	7.8	6.0	8.0	7.0
Compression	24.2	24.4	17.5	17.0	14.0
Expanded Bead	14.8	15.5	5.0	8.0	7.0
Transfer Molding	8.1	8.0	6.0	5.5	4.5
Total	717.8	731.9	540.5	597.5	591.5

[a]Revised from 1984 edition.
Source: *Modern Plastics* Magazine

SHIPMENTS OF SINGLE SCREW EXTRUSION MACHINERY

(in number of units)

SCREW DIAMETER	1980	1981	1982	1983	1984
Up To But Not Including 1¼"	a	a	a	a	a
1¼" Up To But Not Including 2"	156	121	129	168	184
2" Up To But Not Including 2½"	127	171	131	126	168
2½" Up To But Not Including 3"	248	254	184	163	267
3" Up To But Not Including 4"	257	182	148	165	198
4" Up To But Not Including 5½"	245	196	127	85	181
5½" Up To But Not Including 7½"	73	64	45	60	106
Includes 7½" & Larger	16	21	8	5	12
Total	1,122	1,009	772	772	1,116

[a] Combined with 1¼"-2"
Note: Includes domestic shipments and exports
Source: SPI Machinery Division

SHIPMENTS OF INJECTION MOLDING MACHINERY

(in number of units)

CLAMP FORCE (Tons)	1980	1981	1982	1983	1984
Domestic Shipments					
0–99	448	c	c	c	c
100–199	344	838	683	848	1,239
200–299	441	433	d	363	485
300–399	465	453	253	b	484
400–499	b	325	276	b	f
500–599	236	d	89	543	f
600–749	82	d	83	f	f
750–1199	28	d	e	f	f
1200–1999	17	d	e	f	f
2000 and Over	—	—	—	106	402
Total	2,061	2,049	1,384	1,860	2,610
Export Shipments					
0–99	37	c	c	c	c
100–199	34	51	25	34	39
200–299	48	31	d	12	22
300–399	31	25	13	b	22
400–499	b	76	25	b	f
500–599	32	d	8	14	f
600–749	33	d	14	f	f
750–1199	6	d	e	f	f
1200–1999	6	d	e	f	f
2000 and Over	—	—	—	2	12
Total	227	183	85	62	95
Total Shipments					
0–99	485	c	c	c	c
100–199	378	889	708	882	1,278
200–299	489	464	d	375	507
300–399	496	478	266	b	506
400–499	b	401	301	b	f
500–599	268	d	97	557	f
600–749	115	d	97	f	f
750–1199	34	d	e	f	f
1200–1999	23	d	e	f	f
2000 and Over	—	—	—	108	414
Grand Total	2,288	2,232	1,469	1,922	2,705

[a] Category was 750 and over in 1979 [b] Combined with 500–599 [c] Combined with 100–199

[d] Combined with 400–499 [e] Combined with 600–749 [f] Combined with 2000 and over

Source: SPI Machinery Division

OTHER SOURCES OF PLASTICS INFORMATION

Business Consulting Groups and Publishers

Business Communications Co., Inc.—9 Viaduct Rd., Box 2070C, Stamford, CT 06906—203/325-2208

Chem Systems Inc.—303 S. Broadway, Tarrytown, NY 10591—914/631-2828

Eldib Engineering & Research, Inc.—613 Springfield Ave., Berkeley Heights, NJ 07922—201/464-2244

Frost & Sullivan, Inc.—106 Fulton St., New York, NY 10038—212/233-1080

Hull & Co.—5 Oak St., Greenwich, CT 06830—203/622-9120

Charles H. Kline & Co.—330 Passaic Ave., Fairfield, NJ 07006—201/227-6262

R.M. Kossoff & Associates, Inc.—10 Rockefeller Plaza, New York, NY 10020—212/246-4035

Arthur D. Little, Inc.—35 Acorn Park, Cambridge, MA 02140—617/864-5770

Margolis Marketing & Research Co.—232 Madison Ave., Suite 905, New York, NY 10016—212/685-1278

Morton Research Corporation—1745 Merrick Avenue, Merrick, NY 11566—516/378-1066

Noyes Data Corp.—Mill Road at Grand Ave., Park Ridge, NJ 07656—201/391-8484

Predicasts, Inc.—200 University Circle Research Center, 11001 Cedar Ave., Cleveland, OH 44106—216/795-3000

Peter Sherwood Associates, Inc.—20 Harlem Ave., White Plains, NY 10603—914/761-3033

Skeist Laboratories, Inc.—112 Naylon Ave., Livingston, NJ 07039—201/994-1050

Springborn Group—P.O. Box J, Hazardville Station, Enfield, CT 06082—203/749-8371

SRI International—333 Ravenswood Ave., Menlo Park, CA 94025—415/326-6200

Technomic Consultants, Inc.—100 Corporate North, Bannockburn, IL 60015—312/295-8900

Technomic Publishing Co.—851 New Holland Ave., Box 3535, Lancaster, PA 17604

Government Publications

Annual Survey of Manufactures—Bureau of the Census

Census of Manufactures—Bureau of the Census

Current Industrial Reports—Bureau of the Census

Foreign Trade Reports: FT 135 (imports), FT 410 (exports)—Bureau of the Census

Guide to Census Bureau Data Files and Special Tabulations—Bureau of the Census

Guide to Foreign Trade Statistics—Bureau of the Census

Producer Price Indexes—Bureau of Labor Statistics

Standard Industrial Classification Manual—Office of Management and Budget

Statistical Abstract of the U.S.—Department of Commerce

Statistical Services of the U.S. Government—Office of Management and Budget

Synthetic Organic Chemicals—International Trade Commission

U.S. Industrial Outlook—Department of Commerce

Newspapers

Chemical Marketing Reporter—100 Church St., New York, NY 10007—212/732-9820

Journal of Commerce—110 Wall St., New York, NY 10005—212/425-1616

Rubber & Plastics News—1 Cascade Plaza, Suite 1Q02, Akron, OH 44308—216/253-2183

Trade Associations & Professional Organizations

American Chemical Society—1155 16th St. NW, Washington, D.C. 20036—202/872-4600

Chemical Manufacturers Assn.—2501 M St. NW, Washington, D.C. 20037—202/887-1100

Chemical Marketing Research Assn.—139 Chestnut Av., Staten Island, NY 10305—212/727-0550

Chemical Specialties Manufacturers Assn.—1001 Connecticut Ave., NW, Washington, D.C. 20036—202/872-8110

Composite Can & Tube Institute—1742 N St., NW, Washington, D.C. 20036—202/223-4840

Drug, Chemical & Allied Trades Assn.—42-40 Bell Blvd., Suite 604, Bayside, NY 11361—212/229-8891

Dry Color Manufacturers Assn.—Suite 202, 206 N. Washington St., Alexandria, VA 22314—703/684-4044

Flexible Packaging Assn.—Suite 500, 1090 Vermont Ave., NW, Washington, D.C. 20005—202/842-3880

INDA—1700 Broadway, New York, NY 10019—212/582-8401

International Institute of Synthetic Rubber Producers—2077 S. Gessner Rd., Suite 133, Houston, TX 77063—713/783-7511

International Isocyanate Institute—P.O. Box 1268, New Canaan, CT 06840—203/966-7555

National Paint & Coatings Assn.—1500 Rhode Island Ave. NW, Washington, D.C. 20005—202/462-6272

Polyurethane Manufacturers Assn.—999 N. Main St., Glen Ellyn, IL 60137—312/858-2670

Rubber Manufacturers Assn.—1400 K Street, NW, Washington, D.C. 20005—202/682-1338

Society of Plastics Engineers—14 Fairfield Drive, Brookfield Center, CT 06805—203/775-0471

Society of the Plastics Industry-Canada—1262 Don Mills Road, Don Mills, Ontario M3B2W7—416/449-3444

Synthetic Organic Chemical Manufacturers Assn.—1075 Central Park Ave., Scarsdale, NY 10583—914/725-1492

Trade Publications

Canadian Plastics—1450 Don Mills Road, Ontario M3B2X7—416/445-6641

Chemical Engineering—1221 Ave. of the Americas, New York, NY 10020—212/997-2464

Chemical & Engineering News—733 Third Ave., New York, NY 10017—212/679-6210

Chemical Week—1221 Ave. of the Americas, New York, NY 10020—212/997-2922

Market Search, Inc.—P.O. Box 2886, Toledo, OH 43606

Materials Engineering—Penton Plaza, Cleveland, OH 44114—216/696-7000

Modern Plastics—1221 Ave. of the Americas, New York, NY 10020—212/512-1221

Packaging Digest—201 East 42nd St., New York, NY 10017—212/867-9191

Plastics Compounding—1129 East 17th Ave., Denver, CO 80218—303/832-1022

Plastics Design Forum—1129 East 17th Ave., Denver CO 80218—303/832-1022

Plastics Design & Processing—700 Peterson Rd., Libertyville, IL 60048—312/362-8711

Plastics Engineering—14 Fairfield Drive, Brookfield Center, CT 06805—203/775-0471

Plastics Focus—545 Fifth Ave., New York, NY 10017—212/503-2913

Plastics Industry News—1129 East 17th Ave., Denver, CO 80218—303/832-1022

Plastics Machinery & Equipment—1129 East 17th Ave., Denver, CO 80218—303/832-1022

Plastics Technology—633 Third Ave., New York, NY 10017—212/986-4800

Plastics World—275 Washington St., Newton, MA 02158—617/964-3030

MONTHLY STATISTICAL REPORT
on
THERMOSETTING & THERMOPLASTIC RESINS

This publication is the only source of monthly detailed data on production and sales & use (captive) available. A sample of the report follows on the next page. The following materials are included:

Epoxy	Polypropylene	Other Styrene-based Polymers
Polyester	ABS	Nylon
Urea	SAN	PVC
Melamine	Polystyrene	Polyvinyl Acetate
Phenolic	Styrene Butadiene Latexes	Polyvinyl Alcohol
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HD Polyethylene	Latexes	Thermoplastic Polyester

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MONTHLY STATISTICAL REPORT
THE SOCIETY OF THE PLASTICS INDUSTRY, INC.
(In thousands of pounds, dry weight basis)

THERMOSETTING RESINS

DECEMBER 1980

RESIN KIND & USE	SALES & CAPTIVE USE						PRODUCTION					
	DECEMBER			YEAR-TO-DATE			DECEMBER			YEAR-TO-DATE		
	1980	1979	% Change	1980	1979	% Change	1980	1979	% Change	1980	1979	% Change
EPOXY (UNMODIFIED) RESINS, TOTAL	30,709	25,639	+19.8	318,756R	331,570	−4.0	26,491	24,829	+6.7	315,039R	361,077	−12.8
Total Exports	3,732	3,496	+6.8	35,547	35,730	−0.5						
Total Domestic	26,977	22,143	+12.8	283,209R	296,240	−4.4						
Bonding & Adhesives	1,931	1,431	+34.9	17,742R	17,454	+1.7						
Flooring, Paving & Exposed Aggregate	1,886	1,481	+27.3	19,231R	19,583	−1.8						
Protective Coatings	13,417	9,648	+39.1	137,308R	146,137	−6.0						
Fiber Reinforced Laminates & Composites	5,164	4,785	+7.9	62,690R	60,268	+4.0						
Tooling, Casting & Molding Resins	2,749	2,417	+13.7	25,664R	30,940	−17.1						
All Other Uses	1,830	2,361	−23.1	20,574R	21,858	−5.9						
POLYESTER (UNSATURATED) RESINS, TOTAL	75,749	76,020	−0.4	921,169R	1,151,581	−20.0	76,524	78,733	−2.8	925,947R	1,147,174	−19.3
General Purpose Resins							66,503	68,719	−3.2	805,583R	1,010,750	−20.3
Fire Retardant Resins							2,757	2,550	+8.1	28,739	32,035	−10.3
Chemical Resistant Resins							7,264	7,464	−2.7	91,625R	104,389	−12.2
Isophthalic Resins							3,830	4,917	−22.1	52,437R	63,158	−17.0
All Other Resins							3,434	2,547	+34.8	39,188R	41,231	−5.0
Total Exports	903	841	+7.4	11,254	14,250	−21.0						
Total Domestic	74,846	75,179	−0.4	909,915R	1,137,061	−20.0						
Reinforced Plastics, Total	59,069	58,428	+1.1	709,229R	905,949	−21.7						
Non-Reinforced Plastics, Total	15,777	16,751	−5.8	200,686R	231,112	−13.2						
LOW-DENSITY POLYETHYLENE 0.940 & BELOW, TOTAL	719,992	666,312	+8.1	7,467,465R	7,814,845	−4.4	675,113	650,391	+3.8	7,290,727R	7,793,223	−6.4
Total Exports	109,576	65,009	+68.6	1,147,442R	897,575	+27.8						
Total Domestic	610,416	65,009	+68.6	1,147,442R	897,575	+27.8						
Film (12 Mils & Below)	610,416	601,312	+1.5	6,320,023R	6,917,270	−8.6						
Sheet (Over 12 Mils)	392,242	383,360	+2.3	4,003,749	4,363,250	−8.2						
Injection Molding	921	1,930	−52.3	18,176	25,825	−29.6						
Wire & Cable	46,555	57,100	−18.5	519,294R	649,975	−20.1						
Extrusion Coating	20,042	34,572	−42.0	335,403	424,139	−20.9						
Blow Molding	44,772	41,001	+9.2	517,406R	539,096	−4.0						
Pipe & Conduit	5,129	4,786	+7.2	65,453R	59,524	+10.0						
Other Extruded Products	2,660	2,293	+16.0	21,768R	32,718	−33.5						
All Other Uses	4,244	5,140	−17.4	56,018R	79,614	−29.6						
HIGH-DENSITY POLYETHYLENE ABOVE 0.940, TOTAL	93,851	71,130	+31.9	782,756R	743,127	+5.3						
Total Exports	413,377	394,243	+4.9	4,393,038R	4,893,243	−10.2	407,174	419,864	−3.0	4,405,021	5,009,839	−12.1
Total Domestic	61,114	54,188	+12.8	526,438R	608,654	−13.5						
Film (12 Mils & Below)	352,263	340,055	+3.6	3,866,600	4,284,589	−9.8						
Sheet (Over 12 Mils)	21,622	14,714	+46.9	201,086	212,399	−5.3						
Injection Molding	7,921	4,541	+74.4	54,937	65,520	−16.2						
Wire & Cable	89,601	84,541	+6.0	937,964	1,073,724	−12.6						
Extrusion Coating	6,285	7,074	−11.2	105,555	125,921	−16.2						
Blow Molding	3,213	2,038	+57.7	27,565	30,242	−8.9						
Pipe & Conduit	138,168	139,521	−1.0	1,573,140	1,724,076	−8.8						
Other Extruded Products	30,468	25,135	+21.2	368,352	400,395	−8.0						
All Other Uses	1,703	2,120	−19.7	24,250	18,931	+28.1						
	53,282	60,371	−11.7	573,751	633,381	−9.4						

SAMPLE